ON THE COVER

SCIENTISTS have long visualized the possibility of employing controlled sound waves for practical purposes, and in recent years several such commercial applications have been made. Fundamentally, sound is made up of vibrations resulting from alternate increases and decreases in pressure. These waves or pulsations are transmitted in gases, solids, and liquids, but not in a vacuum. The characteristics of the waves depend upon their origin. Some that are too high-pitched to be heard by human ears are generated by high-speed air sirens. Minute particles of solid or liquid substances suspended in air tend to follow the vibratory movements of the waves, while larger ones remain comparatively still. Thus collisions take place, and hundreds of particles combine into larger ones that can be removed with standard equipment. This is the basis of the aerosol agglomeration method by which dust and mist particles can be extracted from air or gases. It holds promise of widespread industrial service. Our cover picture illustrates how ultrasonic sound waves can be made to maneuver talcum powder into seriated rows resembling wind-blown or wave-washed beach sand. Another picture on this subject appears on Page 48.

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IN THIS ISSUE

THE Kiewa Project is not only Australia's most ambitious scheme for hydroelectric-power development but also ranks among the largest undertakings of this kind launched thus far in the Southern Hemisphere. High-lighting Kiewa's engineering features is the location of five of its six generating stations underground. Details are given in our leading article.

•

SINCE iron is the basis of our economy, and American iron-ore deposits are being fast depleted, great interest attaches to the efforts being made in the wilds of Labrador to develop an additional source of supply. Although thousands of square miles of territory remain to be prospected, enough high-grade hematite has already been proved to warrant the huge expenditures necessary to begin mining. Plans for actual production are now being put on paper. Page 32.

•

IN SECTIONS where oil-field piping is relatively easy to obtain it sometimes serves instead of structural steel to support small buildings. One Texas concern hit upon the idea of also using it as an air-distribution system. Page 38.

•

PNEUMATIC tree pruning is expanding rapidly on the Pacific Coast, and orchardists elsewhere in the country will no doubt adopt the idea. The method lends itself well to general arborial work and should prove especially useful for service in parks and on golf courses and large estates Page 40.

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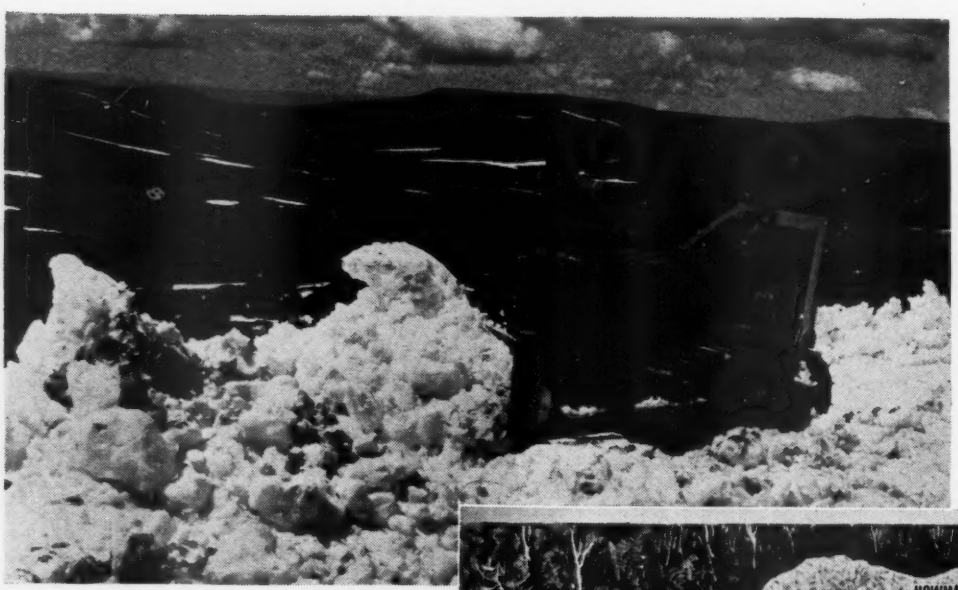
Kiewa Hydroelectric Project

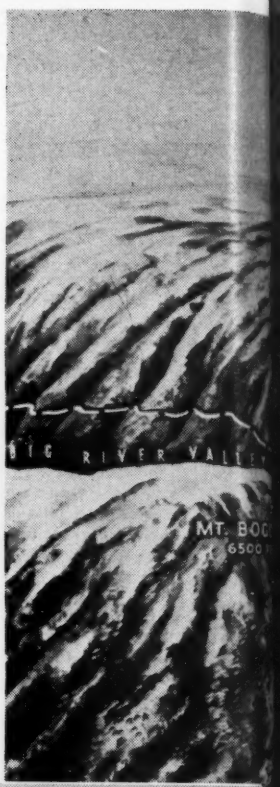
Construction in Australian Alps Will Add 387,000 Horsepower to Victoria System; Five of Six Generating Stations are to be Underground

N. O. Hall



HIGH-ALTITUDE TERRAIN

A bulldozer clearing snow on the Bogong High Plains overlooking the saucerlike Rocky Valley, site of one of the two large storage reservoirs that will feed water to the chain of power stations.



ELECTRIC energy in the State of Victoria in southeastern Australia is supplied well-nigh wholly by a system of interconnected generating stations of which the most important is a steam plant at Yallourn about 90 miles east of Melbourne. This station is situated on the edge of the world's second-largest open cut of brown coal, of which there are enormous deposits in that part of the commonwealth, and burns the fuel in its natural state. Three other associate steam plants located in Melbourne, Geelong, and Ballarat, respectively, operate on lignite briquettes made at Yallourn. Also included in the system are several hydroelectric stations.

Production and distribution of electric power in Victoria are in charge of what is known as the State Electricity Commission—briefly, the S.E.C., a semi-government authority that was created in 1918 by the Victorian State Parliament. As early as 1919 this commission began to investigate the possibility of developing the water-power resources of Victoria's mountainous northeast—the Australian Alps. The result of those investigations was the Kiewa Project, on which work was started in 1937. Much delayed on account of the war, the

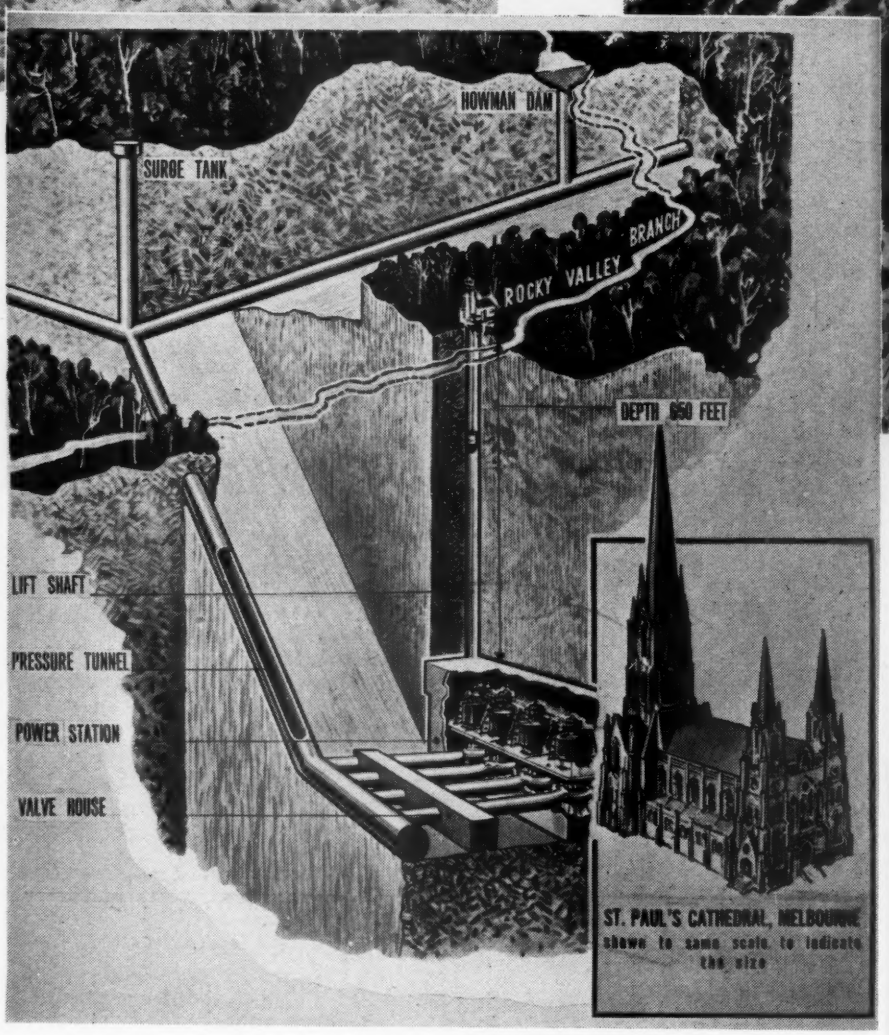
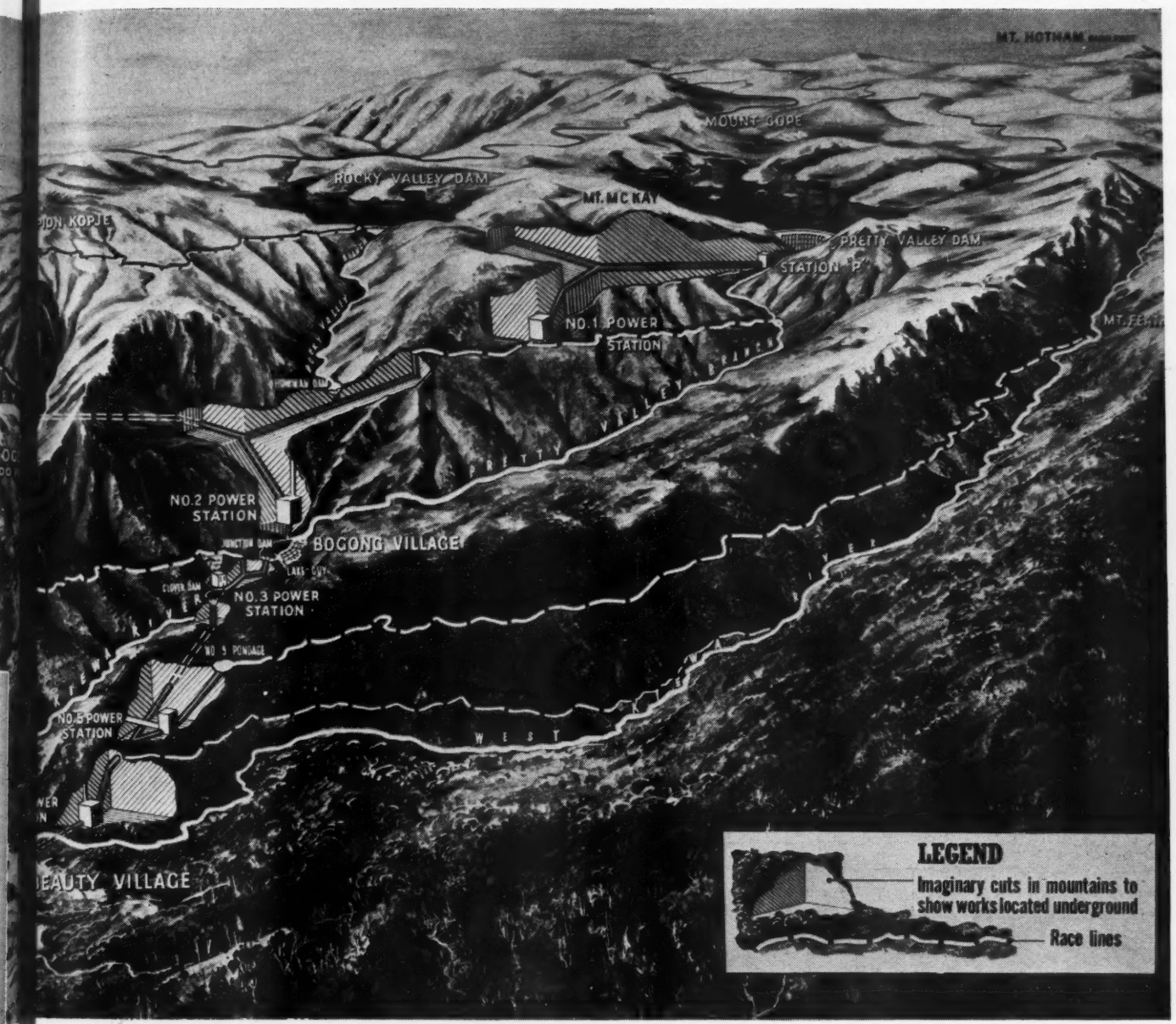


DIAGRAM OF NO. 2 STATION

In this largest of the six power plants four generators, with a capacity of 24,500-kw. each, will occupy a 220x40-foot chamber to be carved in rock 650 feet underground. No. 2 Station will be completed last, being sheduled for service in 1956.



GENERAL SCHEME OF OPERATIONS

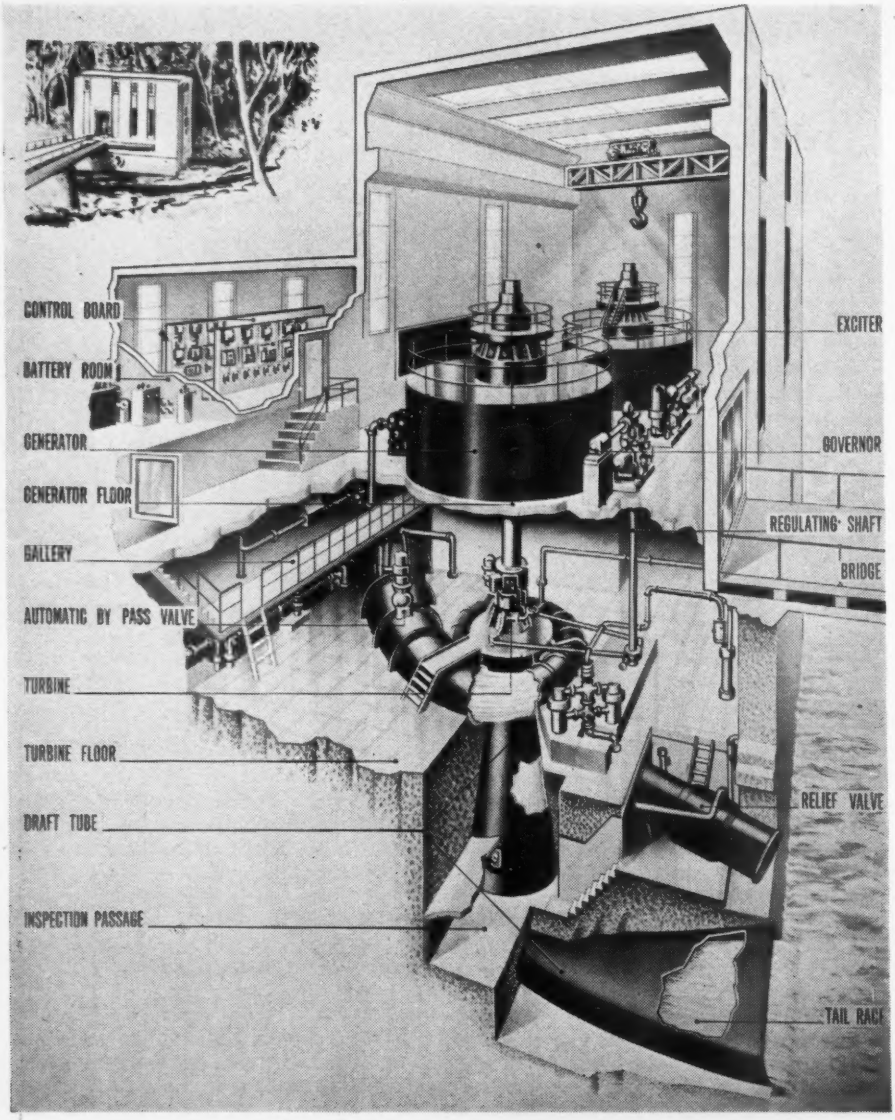
Artist's conception of the complete Kiewa development, showing how water from high drainage areas will be made to do multiple duty. No. 3 Station has been in service since 1944, work on No. 4 is underway, and the four others are to be completed by 1956. The project involves building five dams and 125 miles of roads, driving 18 miles of tunnels, constructing 150 miles of flumes, excavating five underground chambers for powerhouses, the installation of seventeen turbogenerators, and the erection of 158 miles of transmission lines.

scheme has been greatly expanded in the meantime and will involve an expenditure of approximately $80 million. When completed in 1956, as planned, it will supply between one-quarter and one-third of all the current generated in the State of Victoria. On the present basis, its total installed capacity will be 289,000 kw., or 387,000 hp., with an average annual output of one million kilowatt-hours.

The Australian mainland is relatively poor in hydroelectric resources. It has an estimated potential of about 2,000,000 hp. of which two-thirds is in the southeastern section of the continent. The Kiewa Project will harness more than one-quarter of the latter resources and will be the largest undertaking of its kind in Australia, in fact one of the greatest in the Southern Hemisphere. It is a bold engineering conception and will make maximum use of a combination of natural conditions unique in Australia—high-level storage sites and large snow-fed catchment areas.

The Kiewa, the name is of native origin and appropriately means "cold water," is a tributary of Australia's biggest river, the Murray, and has its source on the Bogong High Plains, an extensive plateau lying at an altitude of 5500 feet and more between Mt. Bogong and Mt. Hotham in Victoria's highest alpine country. From four to six months each winter this tableland and the surrounding mountains are deeply covered with snow which melts in late spring, feeding a multitude of creeks and streams. In summer it has the appearance of a rolling upland, treeless except for clumps of gnarled stunted snow gums interspersed with high rocky outcrops and opening out into many shallow, luxuriantly grassed valleys that serve as pasture for thousands of cattle.

Two of these saucerlike tracts, Pretty Valley and Rocky Valley, are vast in extent and the source of two branches of the East Kiewa River. These streams drain most of the plateau, flowing on a level grade through their valleys but falling steeply after leaving the Bogong High Plains through narrow outlets in the mountains to the north. About 7 miles from the tableland the two East Kiewa forks unite at an elevation of 2200



NO. 3 STATION

Cutaway drawing explaining operation of the generating units which have been in service since 1944.

feet and continue to descend to the flats above Tawonga, 14 miles from the High Plains. In this distance the river drops from an altitude of about 5500 feet to 1200 feet. Divided from the East Kiewa watercourse by Mt. Fainter, a long ridge, flows the West Kiewa. This river rises near Mt. Hotham and drains the deep narrow valley, which is flanked on the other side by razorbacked Mt. Feathertop. It joins the East Kiewa at Tawonga.

The Kiewa plan is based on the features of the terrain on and adjacent to the Bogong High Plains and, fundamentally, on two natural high-level storage sites—Pretty and Rocky valleys. The two reservoirs to be created there by damming the two branches of the East Kiewa will impound a large volume of water that will be replenished continually from a catchment area with a combined snow and rainfall averaging 80 inches annually and that will be used for power generation in several stages throughout a total available head of 4300 feet.

From the main storage basins, the water will be conveyed by a system of tunnels through a chain of five power stations. Included in the scheme is a separate tunnel that will divert water from the Big River, a tributary of the Mitta Mitta, and greatly augment the flow through the three lower plants. Water from the West Kiewa River catchment area will be carried by a race or flume to be cut in the slopes of Mt. Fainter ridge at a level high above the steeply falling natural watercourse. It will serve to operate a sixth powerhouse before entering the tunnel carrying the main flow to Station No. 4—the lowest in the chain. An interesting feature of the scheme is that five of the plants will be underground, the exception being No. 3 which is already built and has been in service since 1944. It has a capacity of 26,000 kw. and draws upon a reservoir formed by a concrete dam at the junction of the East Kiewa's two branches. Bogong Village was established there at the same time to house the construction force.

The next powerhouse scheduled for completion is No. 4. It will have a total installed capacity of 60,000 kw., but when put in operation in 1951 will have an output of only 45,000 kw. It will be housed in a chamber 137 feet long, 84 feet high, and 35 feet wide, and will be reached by a vertical shaft 450 feet deep. Station No. 1 is also to be put in service in 1951 and will be equipped to generate 60,000 kw. The largest in the group, No. 2, is to be ready in 1956. It will be 220

BOGONG VILLAGE

The first of two construction towns for housing workmen and their equipment. In the foreground is Junction Dam, and behind it Lake Guy which is temporarily supplying water to No. 3 Station, a mile away.

feet long, 40 feet wide, and 650 feet below ground, and each of its four generators will develop 24,500 kw. Plant "P," which is directly below Pretty Valley Dam, and No. 5, the second lowest in the system, will have a combined capacity of 45,000 kw.

The whole project is shown in detail in an artist's drawing and involves the construction of five dams, the excavating of 150 miles of race lines, the driving of 18 miles of tunnels, the carving of five chambers out of rock underground, and the installation of seventeen turbogenerators. It will also necessitate the building of about 125 miles of roads in steep mountainous country and of a 158-mile transmission line.

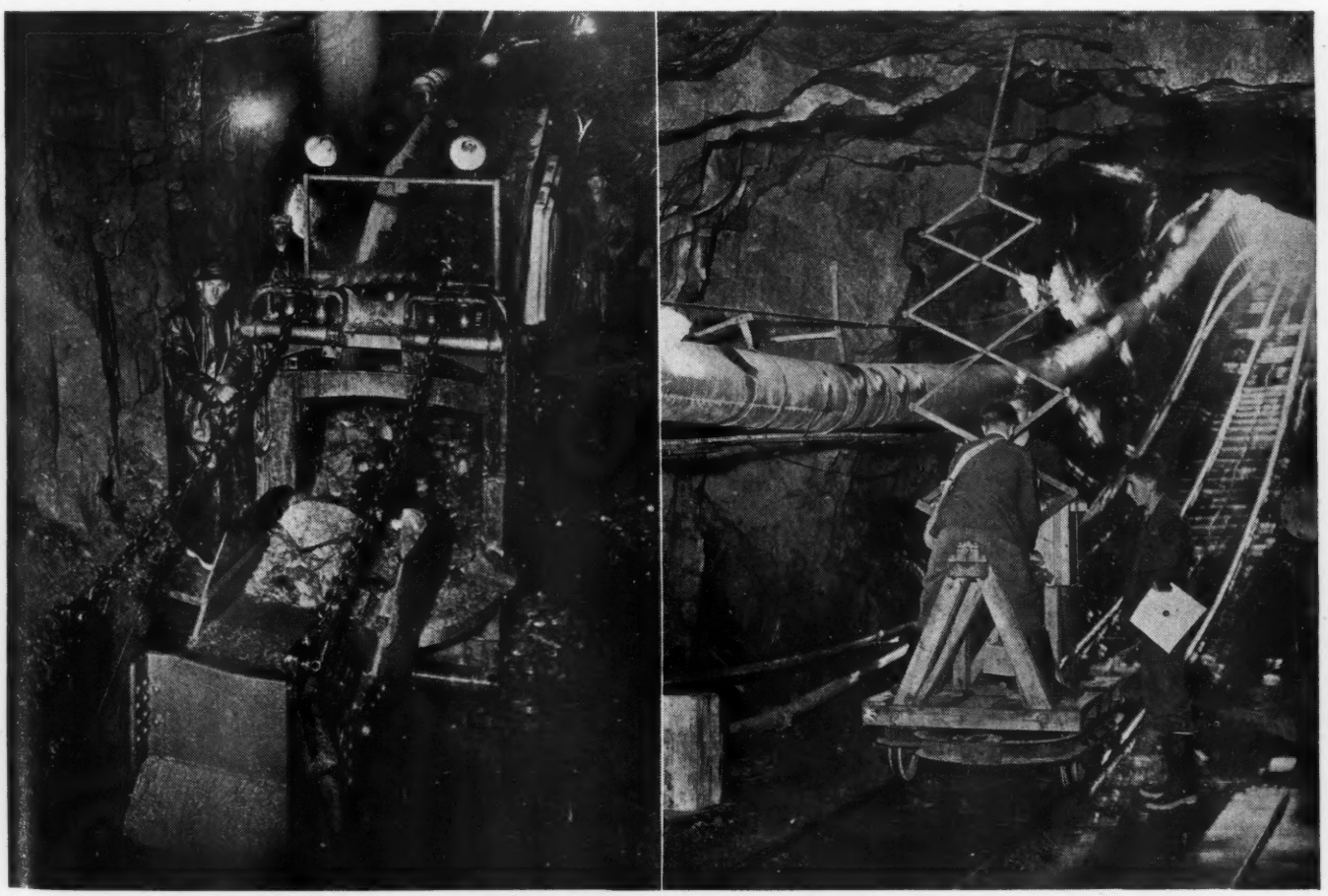
Kiewa will have seven reservoirs to impound and control the drainage from a catchment area of 175 square miles. Besides the two principal basins on the Bogong High Plains there will be small pondages so that each powerhouse can regulate the main flow, as may be required. This will make it possible to operate any combination of plants and gives flexibility to the whole system. Pretty Valley Reservoir will be the largest in the group. It will cover nearly 4 square miles, have a maximum depth or water level of 190 feet, and contain 160,000 acre-feet at full capacity.

Pretty Valley Dam will be of reinforced-concrete, multiple-arch construction, curved in plan. Its foundations will extend 50 feet into solid granite, it will rise above the stream bed to a maximum height of 211 feet, and its length at the crest will be 1250 feet. About 200,000 cubic yards of concrete and 3000 tons of steel reinforcing will be required to build the structure. In addition to the main dam, the creation of Pretty Valley Reservoir will necessitate closing three low saddles in the watershed with subsidiary dykes of earth and rock. The largest of these, Cope Dyke at the southern end, will be 70 feet high, about half a mile long, and will include the spillway section approximately 5590 feet above sea level. The others will be known as the East and the West Dyke.

Five miles from Pretty Valley Dam and 150 feet lower will be Rocky Valley Dam which will impound 22,000 acre-feet. It will be a compacted earth-core and rock-fill structure 100 feet high, one-third of a mile long at the crest, and call for the use of approximately 835,000 cubic yards of earth and rock, which is obtainable close to the site. The spillway will consist of a vertical shaft connected to a large diversion tunnel. The two great barriers will draw upon a watershed of 47 square miles, each collecting the run-off from its own catchment area. Rocky Valley Reservoir will receive an added supply diverted by a race from 32 square miles on the High Plains. Excess water that cannot be stored in Rocky Valley will be pumped across to Pretty Valley to avoid waste.

Of the small pondages that will take care of diurnal flow requirements only Lake Guy has been created by the building of Junction Dam. The latter serves Station 3 which, as already mentioned, is the only one now in operation. Howman and Clover dams for plants Nos. 2 and 4, respectively, are still to be constructed. All will be of concrete-slab and buttress design. A fourth lake can be formed above Powerhouse No. 5 without the need of rearing a dam. Several of these storage basins will receive water from flumes tapping nearby creeks to supplement the main flow.

All the water used in the system will finally be discharged from the tailrace tunnel of No. 4 station into a large artificial lake lying at the foot of the mountain ranges and below Mt. Beauty Village. This pondage will regulate the flow of water returned daily to the natural course of the West Kiewa River at a



TUNNELING SCENES

Driving one of the inclined tunnels or penstocks that will carry water to the turbines of underground generating stations. A Conway shovel is shown at the left loading muck at the heading. The other view shows engineers using a pantograph to measure the excavation. Drilling is done with drifter drills mounted on carriages.

point upstream from its junction with the East Kiewa.

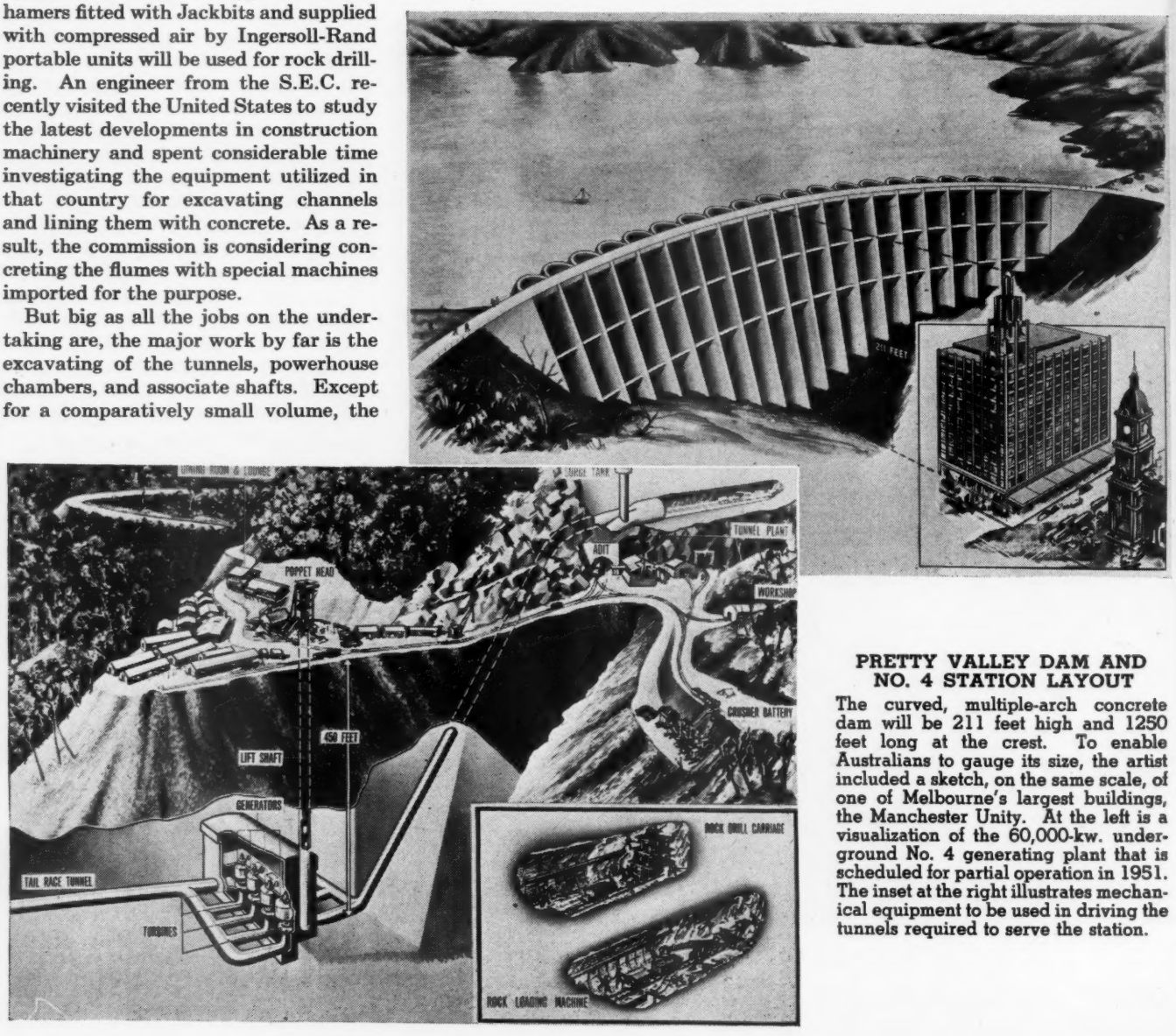
Building of the 150 miles of concrete-lined races is one of the largest of the construction jobs involved in the project. They will vary in length from 1 to 31 miles and range in capacity from 3 to more than 700 second-feet at elevations ranging from 5500 to 1800 feet. The finished channel for a flume carrying approximately 350 second-feet will be about 18 feet wide at the top, 3 feet at the bottom, and 6 feet deep. While this is not sizable, the fact that the channel must be excavated in steeply sloping mountainsides means that the volume of rock removed per foot of channel will be large. In addition to the flumes themselves, it will be necessary to build access roads alongside for maintenance purposes. These will be just wide enough to accommodate a narrow-gauge railroad in order to reduce the amount of excavating to a minimum. Traction will be by small diesel locomotives.

As far as practicable, all work in connection with the race lines will be done by mechanical means. Type JB-4 Jackhamers fitted with Jackbits and supplied with compressed air by Ingersoll-Rand portable units will be used for rock drilling. An engineer from the S.E.C. recently visited the United States to study the latest developments in construction machinery and spent considerable time investigating the equipment utilized in that country for excavating channels and lining them with concrete. As a result, the commission is considering concreting the flumes with special machines imported for the purpose.

But big as all the jobs on the undertaking are, the major work by far is the excavating of the tunnels, powerhouse chambers, and associate shafts. Except for a comparatively small volume, the water from the storage reservoirs will be carried by a system of tunnels driven through rock for a distance of about 18 miles. These conduits will range in cross section from 7x8 feet to 16x20 feet. The largest will be the tailrace tunnel of Station No. 4. It will discharge the water at a maximum rate of 1400 second-feet. The longest will be the 4-mile Big River conduit that will divert water from that stream into the system at a point below Howman Dam. All alignments have been tested by diamond drilling to determine ground conditions, and the indications are that the tunnels will, for the most part, penetrate solid rock. Where bad formations are encountered they will be lined with concrete; where they are under pressure they will be steel lined.

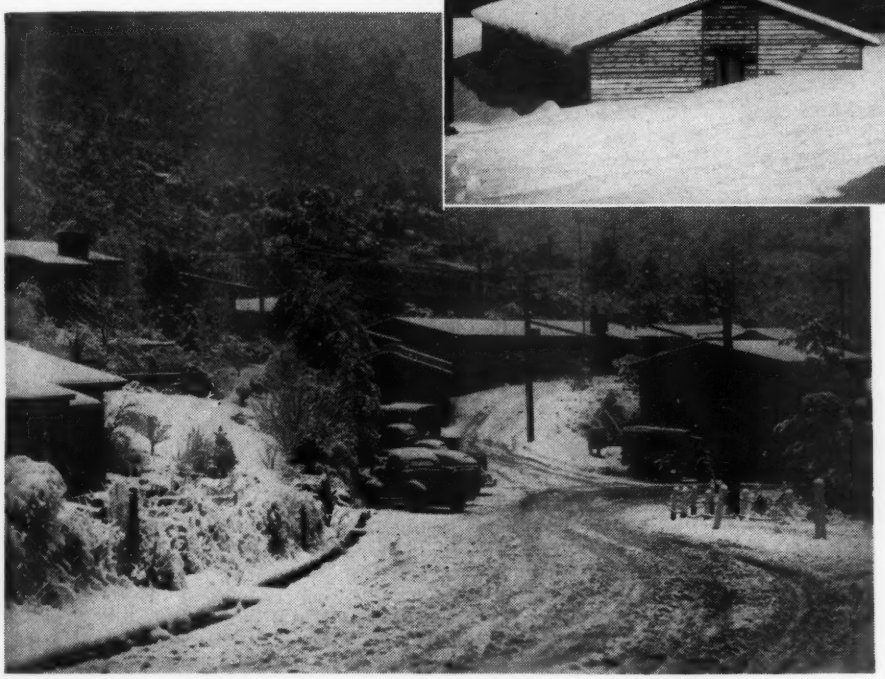
At present, drilling is proceeding in the headrace and tailrace tunnels of Plant No. 4, the second to be put in operation. The former is 12,000 feet long, 15x15 feet in section, and is being driven through granodiorite. The tailrace is 16 feet wide, 20 feet high, and more than 2 miles long. So far decomposed granite has been encountered there, and until solid ground is struck that work will be slowed down. The method followed in driving the headrace tunnel will be generally practiced throughout and can therefore be taken as an example. Drilling is done from a jumbo on which are mounted seven 3½-inch-bore power-feed drifters using Jackbits with Type 1 thread. Starters are 2 inches in diameter.

The drilling round consists of up to 80 holes and is blasted with 250-300 pounds of gelignite. This charge breaks about 65 cubic yards of material and represents an advance of approximately 8 feet. Muck is loaded by a Conway 75 shovel into 6-cubic-yard side-dump cars running on a 3-foot-gauge track. Shunting is done by means of a California switch which is moved forward as the heading advances. Battery-type locomotives are used for haulage. In smaller-bore tunnels, Eimco rocker-shovels will be substituted for Conway loaders and 3-yard Granby cars for the 6-yard size. Jumbos also will be smaller.



PRETTY VALLEY DAM AND NO. 4 STATION LAYOUT

The curved, multiple-arch concrete dam will be 211 feet high and 1250 feet long at the crest. To enable Australians to gauge its size, the artist included a sketch, on the same scale, of one of Melbourne's largest buildings, the Manchester Unity. At the left is a visualization of the 60,000-kw. underground No. 4 generating plant that is scheduled for partial operation in 1951. The inset at the right illustrates mechanical equipment to be used in driving the tunnels required to serve the station.



AUGUST DAY IN ALPS

Winter views of the construction village of Bogong mantled in white by a heavy snowstorm at a time when most Americans were mopping perspiration from their brows. The Australian Alps, while lacking the loftiness and ruggedness of their European counterpart, are massive uplands. They range from 3000 to 7340 feet (Mt. Kosiusko) in altitude and are treeless above 5000 feet. They yield some minerals, but the water that comes from their abundant snow and rainfall is their biggest asset.

Because the tailrace tunnel of No. 4 powerhouse is larger than that for the headrace, it was not possible to design a carriage for it that could travel on a 36-inch-gauge track and yet cover the full working face with its side platforms in drilling position and be no wider than 5 feet, the necessary maximum, with platforms lowered. It was therefore decided to build a portal type with an opening 7 feet wide and 9 feet high through which the Conway mucker, locomotives, and trains could pass. Twelve drifters are mounted on this jumbo, ten at the front and one on each side, and as it obviates the use of a California switch it incorporates a cherry picker operated by pneumatic cylinders.

Connecting the several powerhouses with the horizontal tunnels will be steel-lined pressure tunnels at an angle of 41° from the vertical. Just how these shafts are to be excavated has not yet been determined, but there is a possibility that large-diameter Calyx drills may be used instead of the usual shaft-sinking methods. To determine just what machines of this type can do, an engineer of the S.E.C. Civil Construction Branch traveled to Peru to watch the performance of a drill capable of cutting a 6-foot-diameter core. As a check on the suitability of the Calyx in Kiewa rock formations, a Type TU-48 has recently been put to work there. This machine cuts a 4-foot core, leaving a smooth circular hole that is ideal for transmitting water.

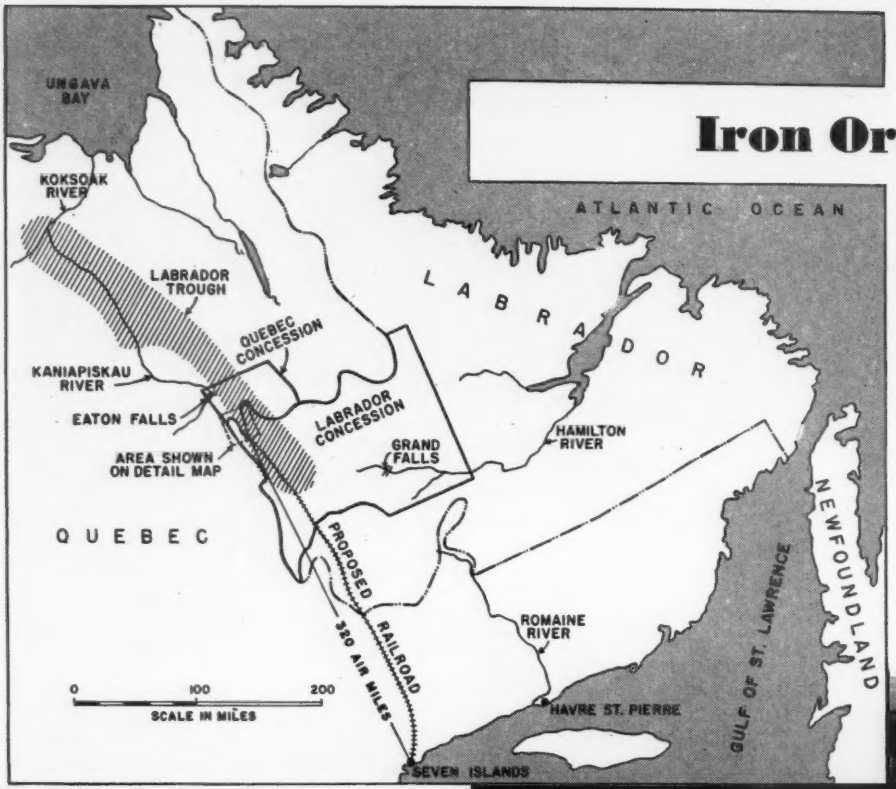
Crushed rock for the 125 miles of surfaced roads will be obtained from tunnel material and, if necessary, from quarries where drilling will be done by X71 drifters on FM-2 wagon mountings. Six of these units have been ordered for the purpose. One stretch between Mt. Beauty and Pretty Valley is already open to traffic. It is 25 miles long and, when completed, will be one of the finest highways through Victoria's scenic alps.

Compressed air for tunneling, shaft-sinking, and other services, is being supplied mainly by Ingersoll-Rand 2-stage, Type 40 compressors of 75 and 90 hp. V-belt driven by electric motors. These units, with their low installation cost and air-cooling, are well suited for construction work. Pressure is maintained at about 110 psi. maximum at the receivers and at around 100 psi. at the machines. To resharpen and reforge Jackbits there is under construction at Mt. Beauty, the central administrative and workshop camp of the project, a large drill-steel and bit shop that will house an IR-40 sharpener, a JMC Jackmill, three JF2 Jackfurnaces, a Size 500 drill-steel cutter, and a Toledo power threading machine for Jackrods.

Kiewa electric energy will be transmitted 158 miles to Melbourne, the capital of Victoria, over a double-circuit steel-tower line for distribution throughout the State's network. It will be carried at 220,000 volts, which is far in excess of the highest now transmitted in Australia. Built on an easement 120 feet wide, the line will pass through long stretches of virgin forest and over mountain ranges reaching a height of 4000 feet. Normal spacing of towers will be 1000 feet, but across Eildon Reservoir, an irrigation storage basin, the cables will have a stretch of 7300 feet. When the project is completed in 1956, as planned, Victoria's steam and hydroelectric plants will have a total capacity sufficient to electrify the entire state and to permit further industrial development.

Iron Ore from Labrador

Commercial Deposits of Rich Hematite Proved by Years of Field Work. Their Development, at a Cost of $200,000,000, Now Seems to be Assured



LOCATION MAP

All the ore so far found is in the crustal rocks of the Labrador Trough, a 350-mile-long structural basin (shaded on map). These sedimentary deposits were laid down horizontally but have been tilted and faulted by subsequent earth movements. Explorations to date have been confined to the area in the small square that is shown in greater detail on another page. At Eaton Falls, just north of the known ore bodies, 500,000 hp. of electrical energy can be developed, but only one-tenth of this amount will be needed for the operations now projected. Grand Falls, 140 miles away on the Hamilton River, is another source of power that could be harnessed, if necessary. The cataract is 700 feet high, exceeding Niagara, and has a potential output of 1,250,000 hp.

DRILL CAMP

One of the several outlying bases used by crews engaged in determining the extent of ore deposits by means of regularly spaced drill holes.

DURING the past few years a bleak, isolated region in northeastern Canada has witnessed the labors of an enthusiastic little band of modern adventurers. The object of the enterprise: high-grade iron ore. Year by year the members have accumulated evidence of the presence there of one of the world's large resources of hematite.

Steel producers in the United States have become keenly interested in the find because it promises to supplement the remaining, precious reserves of such ores in the Lake Superior area. The Canadian Government is interested in this potential source of scarce American dollars—for most of the ore will be sold in the United States. The governments of the Province of Quebec and of Newfoundland are well satisfied with the prospect of substantial employment for many of their people through the development of this section of their hinterland.

The ore bodies are partly in Labrador and partly in New Quebec. The region is in the center of the Ungava Peninsula, 320 miles north of Seven Islands, a deep water port on the Gulf of St. Lawrence. The existence in Labrador of a vast formation of iron has been known since 1896 when a Canadian geologist described it accurately after several seasons of arduous travel along canoe routes. For 40 years it lay beyond the reach of prospectors, who located the actual deposits only by a painstaking foot-by-foot search.

Systematic prospecting was initiated in 1936 when A. H. McKay of Montreal formed the Labrador Mining & Exploration Company and received from the Government of Newfoundland a 20,000-square-mile concession covering the upper basins of the Hamilton and Naskaupi rivers. The area was combed for gold and nonferrous metals without substantial success, and outcroppings of iron ore discovered incidentally failed to attract more than casual attention. It was the airplane that made prospecting possible in this far-off region.

In 1942 a controlling interest in the Labrador Mining & Exploration Company was acquired by Hollinger Consolidated Gold Mines, one of Canada's largest gold producers, and a concession of 3900 square miles was obtained on the Quebec side of the border from the Provincial Government. At first, as before, the search centered on precious and nonferrous metals. Soon thereafter the finding of additional outcrops of high-grade hematite indicated the possibility of a large iron-ore field. Prospecting was then switched to iron ore, and before long it became evident that this was the

PANORAMA AT BURNT CREEK CAMP

This is bleak and uninviting country. Glaciation removed virtually all the surface soil, so farming is impossible. Trees are confined mostly to the valleys. Before prospectors came, the region was seldom visited except by Indian trappers who went in by canoe routes each fall and came out in the spring. In the foreground are seen second growth pines rising amid the gaunt skeletons of larger trees that were killed by a forest fire 40 or 50 years ago. Origin of the camp's name can be readily deduced from their presence.

"best bet" of the area. A minority interest in both concessions was acquired by the M. A. Hanna Company of Cleveland, Ohio, one of the principal iron-ore producers in the United States, which thus became Hollinger's partner in the venture.

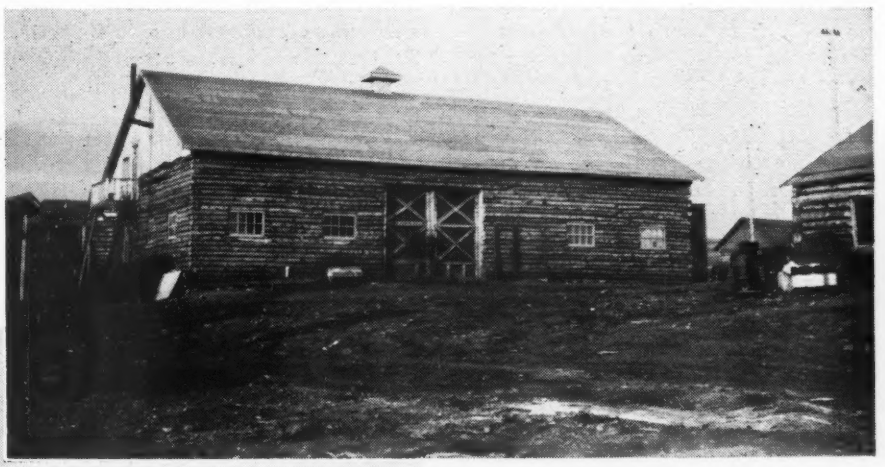
Until the end of the war comparatively little exploring could be done, but in 1945 many other outcrops of ore were discovered. In 1946 substantial experimental drilling was done with a view to determining what kind of drill and what technique would best meet local conditions. At the end of the following year about 140 million tons of high-grade ore had been proven. In 1948 the total had reached 300 million tons—the amount the owners had decided would be necessary to warrant the expense of providing the railway, port, and equipment that would be required to exploit the field.

The average composition of the iron ore proved up to the end of the 1947 season is given in the table on Page 34. Analysis of the ore proved during 1948 will not be available for a little while, but it is known that the 300 million tons of positive ore averages about 59.5 percent iron (dry analysis) and 7 to 8 percent silica.

The rock series in which the ore bodies have been found is strikingly like that in the Lake Superior region. Ancient sediments of Huronian age, bounded on the northeast by volcanics, occur in a strip 350 miles long and approximately 20 miles wide and extend southeastward from Ungava Bay toward the St. Lawrence River. A part of the series is composed of a banded siliceous-iron formation, several hundred feet thick, in which the hematite deposits lie. The beds were originally laid down horizontally, but now they dip to the northeast. Fortunately, repeated thrust-faulting brought the iron formation to the surface again and again, and this has certainly been of inestimable value to the prospector.

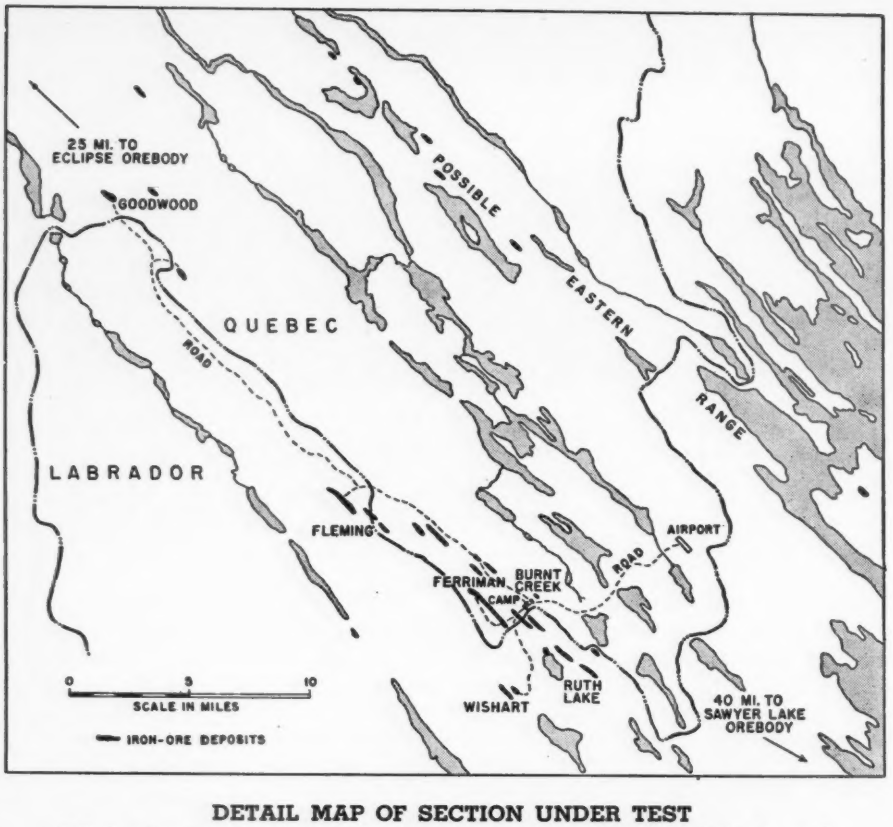
While iron-bearing material exists throughout the whole length of the Huronian rocks, deposits of commercial grade and size have so far been discovered only on the two Hollinger concessions and within an area of 50 miles on the Quebec side of the border and of 40 miles on the Newfoundland side, or 90 miles in all. While no ore bodies have been located beyond these limits, there is no reason why they should not be found there because conditions throughout the entire 350-mile iron formation seem to be favorable to their occurrence.

Most of the proved ore lies in the central part of the 90-mile stretch and astride the border. In fact, several of the deposits are cut in two by the boundary, which is a height of land. Burnt Creek



PROSPECTING BASE

Burnt Creek Camp (left), headquarters of the exploration crews, consists of several quonset-type buildings that were flown in and of a scattering of well-built log structures. However, the camp has electricity (notice street light on pole), and a radio station links it with the outer world. The settlement itself is underlain by a large iron deposit that was discovered by accident while a drill was being tested. The view above shows the log machine shop.



DETAIL MAP OF SECTION UNDER TEST

This is a large-scale presentation of most of the area within the rectangle on the location map shown on the first page. Exploration has so far been limited to the deposits lying largely in the left (west) half of the section. However, six outcrops of ore have been noted about 12 miles to the east, indicating another possible productive range parallel to the first one. The rock structure runs northwest-southeast, as evidenced by the disposition of the iron outcrops and the elongated lakes in depressions between ridges.

Camp, the present center of operations, is in the midst of this section, with ore in all directions and even under it. Forty miles to the south is the isolated Sawyer Lake ore body, one of the first to be discovered; 25 miles to the north is the Goodwood deposit with 45 million tons of ore, the largest proven to date; and 25 miles farther north is the Eclipse ore body with 29 million tons. A score of deposits close around the camp constitute the bulk of the 300 million tons of positive ore. How many more lie among and beyond them has yet to be determined.

With few exceptions, the known ore bodies have been found as natural outcrops. As most of the surface is covered by a foot or two of glacial debris it is likely that many other beds lie concealed beneath the blanket and will be brought to light by more intensive prospecting. In fact, one under Burnt Creek Camp has already been discovered by accident.

A light churn drill, newly brought in, was assembled near the machine shop for a trial run to check its performance. After penetrating 2 feet of overburden the drill struck ore and continued in ore averaging 65 percent iron to a depth of 367 feet. Thus, the chance of finding additional ore bodies within the proved area seems to be excellent.

Twelve miles northeast of the zone in which the deposits lie there is a parallel range in which six promising outcrops of hematite have been located. None of these has yet been drilled, but they give promise that a second series of ore bodies may be established in time.

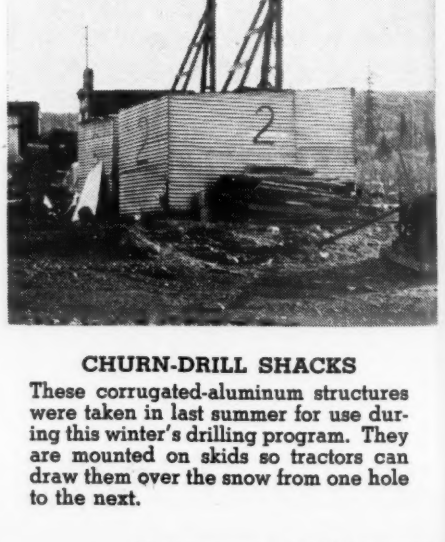
In order to determine what type of drilling equipment would be most suitable for the work, it was necessary to do a good deal of experimenting. Diamond drills were tried first, but most of the ore was too soft to give a core and the holes caved badly. Homemade chopping bits were then fitted to the rods and samples brought up every 5 feet as cuttings and sludge. To assist in cutting, a 350-pound weight was attached to the rod. This conversion of the diamond drill to a chopping machine was successful, and units so modified have continued in service because they have proved to be the most economical type for drilling certain of the ore formations. Light churn drills were originally brought in to test for ore beneath the overburden. However, they were found to be equally satisfactory for drilling in the ore itself, and in many cases have been employed to complete the holes. The most effective equipment used up to date are the heavy churn drills mounted on tractor treads. They not only drill faster than the others but give good samples.

A specimen is taken from the sludge in each 5-foot length of hole. In the field laboratory at Burnt Creek the samples are dried and quartered and a preliminary assay is made as a guide in drilling and computing preliminary estimates of tonnage. Duplicates are sent to the Iron River, Mich., laboratories of the Hanna Company, and the results of both analyses serve as a basis for the final estimates of grade and tonnage.

As has been previously mentioned, prospecting of the area was not practicable so long as canoe routes were the only avenues of approach. Not until the advent of the airplane did the central part of the Labrador peninsula become accessible. So far all travel as well as the delivery of all supplies in connection with the mineral development has been by air. At first, with small machines provided with floats for landing on lakes, transportation costs were high, averaging 73 cents a pound in 1943. Four years later the Knob Lake airstrip was constructed 10 miles from Burnt Creek Camp by means of a grant from the Canadian

QUANTITY AND GRADE OF ORE PROVED TO END OF 1947

Long Tons of Iron Ore	Iron	Manganese (*Dry Analysis*)	Phosphorus (*Dry Analysis*)	Silica (*Dry Analysis*)
61,081,000 (bessemer)	62.3	0.33	0.030	7.48
61,460,000 (nonbessemer)	58.6	0.63	0.126	6.36
17,277,000 (manganiferous)	51.3	7.50	0.148	5.92
139,818,000				



CHURN-DRILL SHACKS

These corrugated-aluminum structures were taken in last summer for use during this winter's drilling program. They are mounted on skids so tractors can draw them over the snow from one hole to the next.

Government. The company purchased two DC3 freighters, and in 1947 the rate per pound was less than one-tenth that of 1943. After bringing in the drills, trucks, bulldozers, and miscellaneous equipment needed in this highly mechanized mining campaign, the two "Dakotas" had ample capacity to serve the crew of 200 men employed in 1948. Already, the road system is close to 100 miles in extent. Some of it is good, much of it still rather primitive. But the only way in and out is still the air lane.

The interior of Labrador is rather desolate in appearance. The ridges contain no soil, just rock debris left by glaciers, and there is only a scattered and stunted growth of shrubs and trees. Gray caribou and dark sphagnum mosses cover large areas. In the valleys lie accumulations of silt, and spruce trees grow to a diameter of 15 to 18 inches at the stump. The local relief, or difference in height between lowlands and hilltops, is several hundred feet and the general elevation about 2000 feet above sea level. In the region are innumerable elongated lakes, some of them large and all trending northwest-southeast with the rock formations.

Until prospectors came there were no human year-round inhabitants in the interior of Labrador. Indian trappers arrived in the fall and returned to the St. Lawrence in the spring with their catch of furs. Without soil, chances of farming are nil. The forest provides enough lumber for local needs, but that is all it can do. Minerals offer the only inducement for settlement.

AERIAL TRUCK HORSES

The operations underway would have been impossible without the airplane. Everything from bulldozers to pins has been freighted in by two company-owned DC-3s. One of them is shown as it was about to leave the airstrip at Knob Lake last October first with a dozen geologists and drillers whose season's work was finished (top view.) Local transportation between the various camps is largely handled by Norseman planes equipped with floats for landing on lakes, which are numerous in the region. This is a famous type of Canadian aircraft used widely in the north country. Many of them served the United States Air Force during the late war for operations in foreign countries.

Natural living conditions in the new iron-ore range are much like those, say, on the Mesabi in Minnesota. Probably the greatest difference arises from the high winds that cause continual drifting of snow in the winter and large accumulations in some of the hollows. Summer, too, is considerably shorter, and it is likely that operations will be confined to a 6-month period. Conditions for mining, on the other hand, are much more favorable in certain respects than those on the Mesabi. A large percentage of the ore stands up in ridges and can be worked by shovels above the line of the railway spurs. Little stripping is required, and no serious pumping problem is in view.

To exploit the iron ore, the main essentials are 350 miles of railroad to reach the St. Lawrence, storage and loading facilities at Seven Islands, hydroelectric power to run the mines, and equipment for both mines and railway. A good rail route has been established, the only troublesome section being the first 80 miles where swift-flowing rivers cut through a mountainous region fronting the St. Lawrence. An excellent grade was found along the Moisie River and its tributaries. Once this escarpment is mounted, the ground to the ore deposits is fairly level and railroad construction will be comparatively inexpensive. Surveys at Seven Islands have shown good port conditions. The shipping season will be ten months, possibly longer.

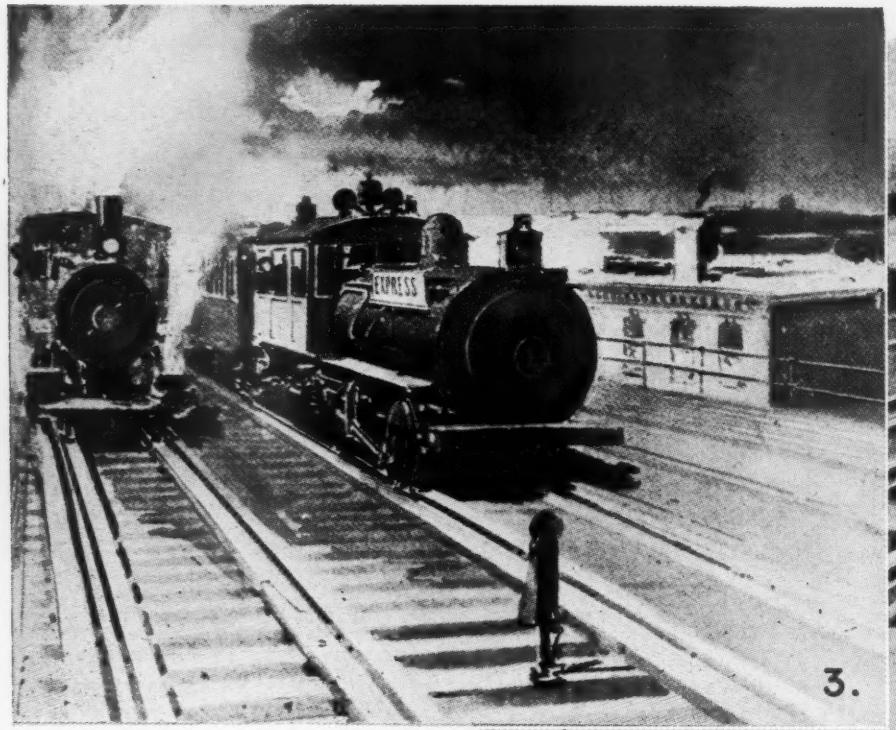
A convenient power site has been located at Eaton Canyon on the Kaniapiskau River and 25 miles from the Eclipse ore bodies. While it may be the source of 500,000 hp. when fully developed, it will, in all probability, be tapped only partially at first to provide about 50,000 hp., which will be sufficient for the mines. The cost of proving 300 million tons of ore has been $5 million. To put the mines into production will involve an expenditure estimated at approximately $200 million. No difficulty is foreseen in raising this sum. To expedite construction of the railroad and hydroelectric development, equipment too heavy to transport by air will be hauled in this winter over the snow by tractor-trains, a freighting method extensively used in the north country.

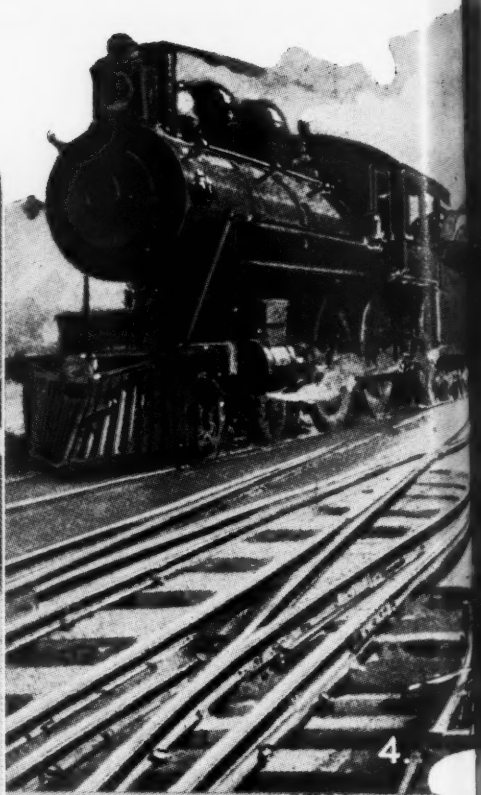
The minimum amount of iron ore that will have to be shipped annually to make the project a paying proposition is set at ten million tons. A small percentage of this can, no doubt, be used in the furnaces at Sydney, Nova Scotia, and some perhaps at Hamilton, Ont. Steelmen in Britain and Belgium have shown a keen interest in the ore, and if exchange difficulties can be overcome those countries might absorb a moderate tonnage. The bulk, however, will have to be sold in the United States, and the great steel district south of Lake Erie is the best market. Up to the present time, the latter has looked to the Lake Superior mines for the ore it needs, but the diminishing reserves there have given plain warning that it would be wise to develop a supplementary source.

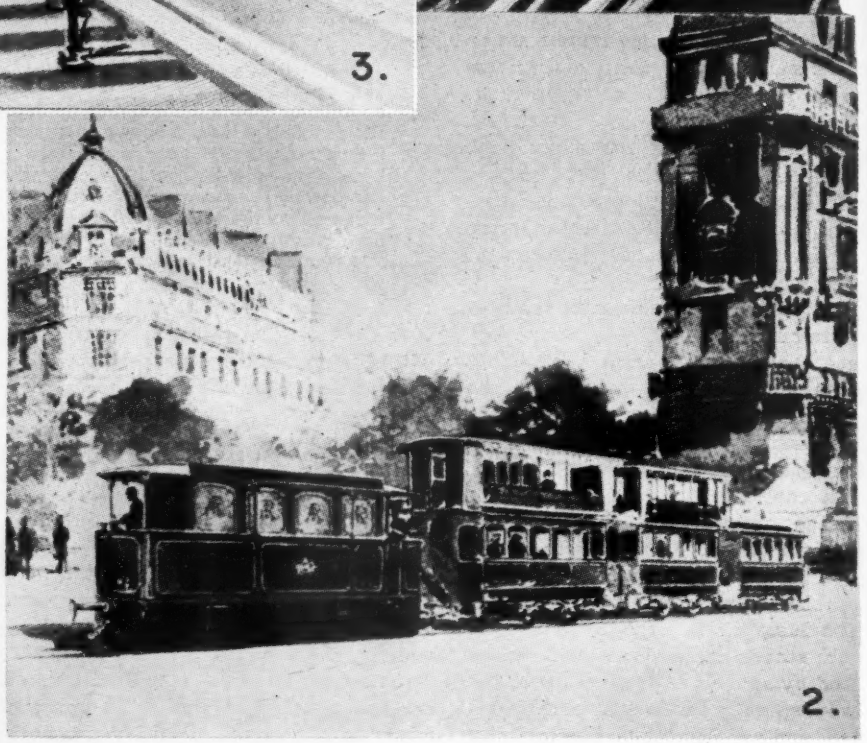
Labrador iron ore promises to augment the supply from the Mesabi range economically provided the St. Lawrence deep waterway is made available. With it, it will cost little more to deliver shipments at the lower lake ports from Labrador than from Duluth. Without the deep waterway it is doubtful if the ore from the new field can be sold profitably in Pittsburgh.

Thus, we are witnessing today a mineral development that ranks among the foremost of the century. Great bodies of high-grade iron ore are not plentiful, and the nations that possess them are fortunate. Canada seems destined to benefit greatly from her Labrador deposits.

Compressed Air in 1896

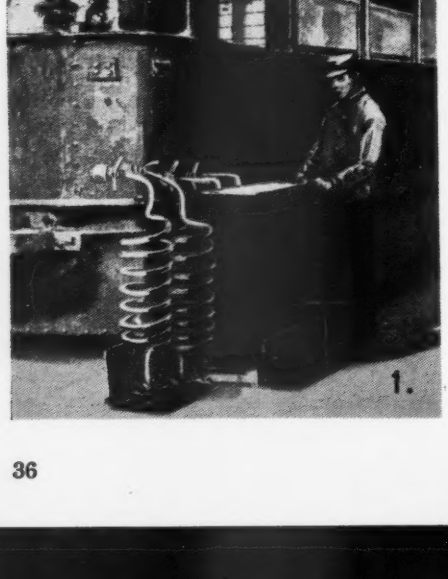






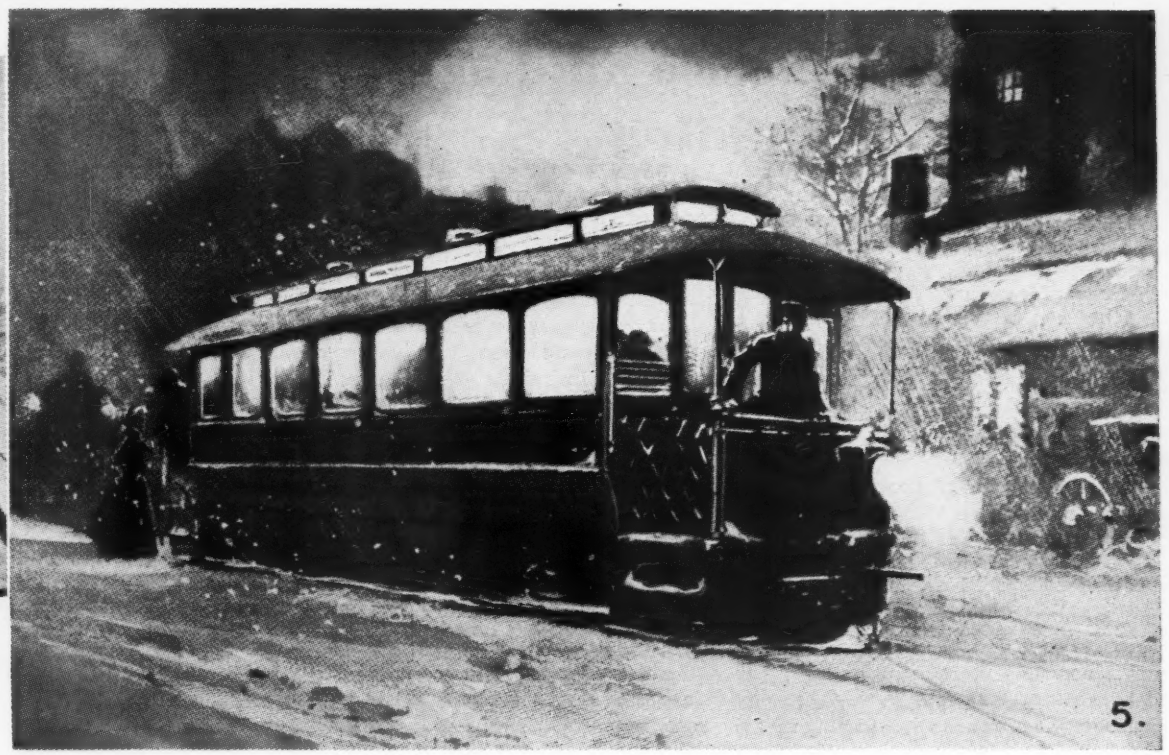
FIFTY-THREE YEARS AGO

1– Recharging storage tanks of Paris street-railway motor car with compressed air at around 2000 psi. 2– Compressed-air motor car hauling train of street cars in Paris. 3– Compressed-air locomotive (right) designed for drawing 5-car trains on the Manhattan Elevated Railroad in New York City. 4– Train in yards of Pennsylvania Railroad with switch in right foreground operated by compressed air. 5– Air-powered street car on 125th Street, New York City.



THE accompanying pictures, reproduced from the December 5, 1896, issue of *Harper's Weekly*, show some then-current uses of compressed air of which only one has survived the changing trends of more than half a century. The illustrations, all freehand drawings by W. Louis Sonntag, Jr., covered a page in the publication, which was at the time perhaps the nation's widest-read weekly. Another full page was devoted to descriptions of the manifold applications of compressed air, which was hailed as "a very wonderful new power which has been rapidly coming into use in the last ten or fifteen years." Some of the information was credited to our own journal, then a fledgling literary project promoted by William Lawrence Saunders, who wrote in his first editorial that "the era of compressed air is now upon us . . . and the science has suffered from want of publicity."

Although the possibilities of air power had been dramatized by its employment in the Hoosac Tunnel in 1866 for operating rock drills and, subsequently, by



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numerous diversified applications, the 1896 American public was little informed as to the practical benefits inherent in pneumatics. Europeans were much more aware of the potentialities of this "new" science, for in Paris compressed air was being piped around to shops and even residences, and in England 150 miles of pneumatic mail tubes were already in use.

In the United States, too, compressed air was serving mankind well in many ways, but it had seemingly been "hiding its light under a bushel." *Harper's* remarked that "it has been, apparently, the Cinderella of the mechanical arts," and attributed this to the fact that "it made its appearance in an age given over to a sort of electrical mania, and there seemed no godmother genius like Tesla or Edison to bring the golden slipper to its neglected hearth."

At the moment, however, compressed air was emerging from obscurity into the sunlight of highly optimistic predictions as to its future. For three months prior to *Harper's* publicity splurge it had been operating two surface cars on 125th Street in New York with a smoothness and quietness that made them stand out in sharp contrast to the regular cable-propelled cars. The former had run 12,000 miles and carried 75,000 passengers "without accident and without incident," which caused *Harper's* writer to venture that "it is an allowable surmise that this is the traction force of the future in large cities, if not in small."

The favorable results achieved with air-powered surface cars led the same company to design and build a compressed-air locomotive to draw a train of five cars on the Manhattan Elevated Railroad between Rector and Fifty-eighth streets. The idea of pneumatic traction did not originate in the United States; it was adopted from France where the Mekarski system was the first to be successfully applied to surface lines. The development that made it operative was Mannesmann's discovery of a way to shape mild steel into seamless flasks capable of storing motive air under high pressure. From those cylinders, carried under the cars and recharged at intervals, the air was fed at reduced pressure to modified steam engines that transmitted their power to the driving wheels through gears. Various American inventors tried to improve upon the French technique, and the Hardie system was the one most used in this country. The air was stored at 2000 psi. pressure, and enough could be charged into a 51-cubic-foot cylinder to propel a car from 15 to 18 miles, including stops. On its way to the engines, the air was passed through a chest of hot water to increase its expansive effect and then through reducing valves to lower the pressure to 130 psi. at the point of application.

How far *Harper's Weekly* went in visualizing busy days ahead for compressed air is indicated by the following excerpt from its article: "The general use of the new power will come only with the advent of large central distributing stations, from which it can be had as freely as is gas or water now. While in a sense it is a rival of electricity, yet it is not impossible that it will soon become a yokemate rather. The alternating electrical current may be employed to transmit cheap power long distances, as from Niagara and the Pennsylvania culm-banks, and this power converted into compressed air at the points of consumption—electricity being probably the best agent for distance transmission, and compressed air the most mobile form of power for immediate use. Even this is mere conjecture, however, since there is at least one engineering genius (George Westinghouse) who has distinctly in view the compression of air at great water-powers like Niagara, conveyance by pipe lines at enormous pressure as far as New York or Philadelphia, and delivery at prices with which electricity cannot compete. But whether as yokemates or rivals, it must be clear to the dullest imagination . . . that we are but on a threshold of the day when these two forces, harnessed and trained, will, from their cheapness and availability, and in their infinite application, lift a considerable share of the burden of physical toil from the shoulders of the race."

The prophecy in the last sentence has been fulfilled, probably even beyond the most optimistic dreams of the 1896 writer. Meanwhile, electricity and compressed air have gone their separate ways, each serving certain fields for which it is best adapted, but also joining forces in numerous directions. Both are still advancing by leaps and bounds, for there seems to be no end to their usefulness.

As for the compressed-air applications illustrated, pneumatic street-car propulsion died aborning, although the same method was vigorously exploited for underground transportation in mines, where it still finds limited use. But the operation of switches by air power under electric control continues to be accepted practice.

Air Piping Also Supports Building

Elton Sterrett

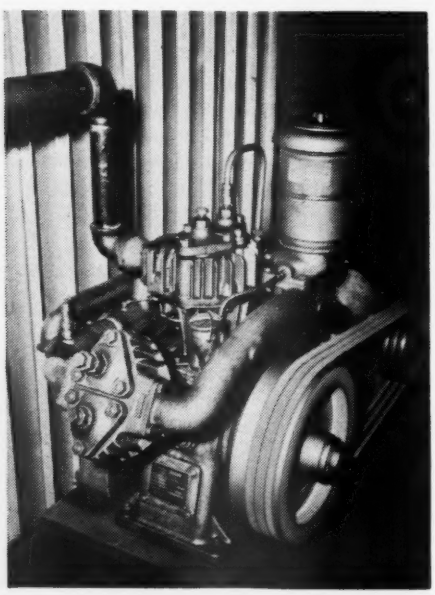
COMPRESSED air is one form of power that is indispensable around the machine shop and should be available at many points to facilitate operations. It may be needed at one place to blow away chips; at others to drive portable drills, chippers, grinders, or other pneumatic tools. Elsewhere it may be required to operate a jack or hoist to handle loads that are too heavy to be lifted manually, or it may have to provide oxygen necessary for the combustion of gas or fuel oil to heat muffle furnaces, etc. Whatever the demand, the air is normally stored in a receiver and delivered to the various working sites by separate pipes or hose lines strung across the floor or suspended overhead.

But one jobbing machine shop, the Forsyth Engineering Company, Houston, Tex., has built a 3-bay structure with a piping system that is unique. It not only carries the air everywhere with the aid of only relatively short lengths of hose but at the same time serves as the supporting framework for the shop. The uprights and main cross members are not the usual structural beams or channels but are 4- and 5-inch extra-heavy pipes tied together by an ingenious method to permit the free flow of air. Instead of the customary structural welds at the points of juncture, the joints are made by pressure welding so that the area common to both a vertical and a horizontal member is open. Thus the entire framework of the building is a widely distributed air reservoir and takes the place of the conventional receiver installed adjacent to the compressor and distributing the air through a network of comparatively small-diameter lines.

The combined storage of the pipes that constitute the skeleton frame of the structure amounts to approximately 470 cubic feet, which is about the capacity of a tank 54 inches in diameter and 26 feet in height. Another advantage of the system is that it eliminates the pressure drop ordinarily experienced when long, small-diameter lines lead from a receiver to distant points of air use. As a receiver 8 feet high and 54 inches in diameter, or even smaller, would probably be furnished to care for the needs of a shop of comparable requirements, the piping provides more than three times the storage of the conventional set-up.

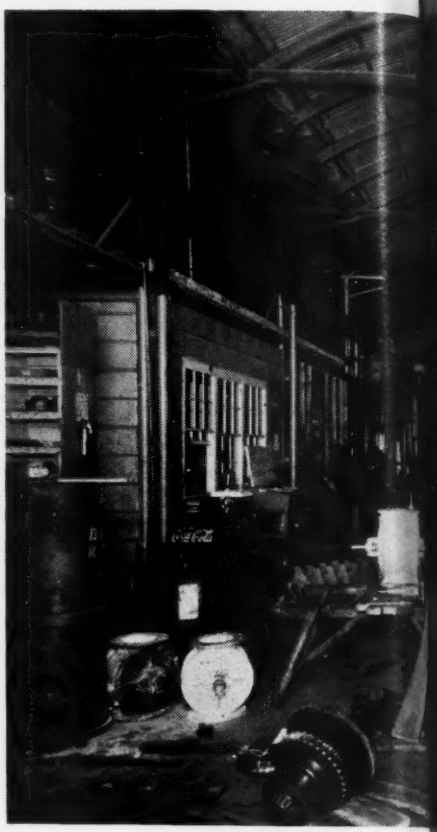
Through the center bay of the building the posts are set in twos, the outer rows carrying the structure and the inner ones supporting the rails for an overhead crane. Each pair of pipes is mounted on a common bed or base plate and tied together about 5 inches above this foundation by a short nipple of heavy 2-inch pipe. This allows a free flow of air between the two columns, giving in effect a double storage unit to within a few feet of the point where the air is taken off for use. This coupling of the lines reduces condensed moisture carry-over to a minimum and makes it possible to utilize a blowing jet immediately upon opening the nozzle valve—it is not necessary first to direct the stream to the floor until the water has been vented.

The upright pipes all act like gigantic drop legs to trap any water that may get past the dehumidifier adjacent to the compressor. There is a drain valve in the base of each single post and one in each pair of center-bay columns. These have been checked experimentally to determine the amount of water that collects in them after normal shop use of air. It was learned that blowing off the pipes closest to the compressor at 3-week intervals kept down the accumulations, while those farthest away showed no water even when checked but once every six months. The vents most frequently opened are equipped with ¼-inch valves, those infrequently used have ⅛-inch petcocks, and others are closed with common pipe plugs which may be either loosened or removed for the time being to determine the water content of each vertical column.



AIR COMPRESSOR

This Ingersoll-Rand Motorcompressor delivers 61 cfm. at 100 psi. pressure. Before entering the piping system, the compressed air passes through a small receiver where most of the entrained water vapor condenses and is removed by an automatic trap.



CENTER BAY

View shows piping that serves the two-fold purpose of supporting the building and distributing compressed air to all parts of it. The inner members of the double vertical columns are surmounted by rails on which the overhead crane runs.

As extra-heavy piping was used for all building posts there is ample wall thickness to allow drilling at any point where an air outlet may be desired. Thus one riser may have multiple taps and another alongside none, depending upon the relation of each to the machine tools in the immediate vicinity. Brackets, tie rods, or other attachments are tack-welded onto the pipes—they do not penetrate or affect the pressure-resisting property of the metal.

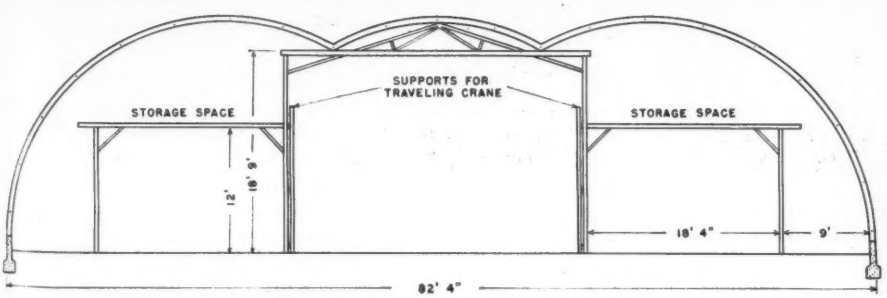
Because the columns which carry the crane rails are sealed on top by the pads on which the rails rest, there is no overhead tie-in, and all air reaches the paired center-bay risers through the horizontal pipes which support the roof. Of the twin columns, the one extending to the roof has the drain, but either may be tapped to supply air locally, the one most advantageously situated with regard to the point of application being chosen. However, there are no connections on the inside, or towards the craneway, as a protection against damage that might otherwise result through fouling of outlets by the chains or load. Regardless

of the pipe used, water cannot rise above the tie-in nipple in the one not equipped for drainage without flowing over into the other, from which it would be removed at the next inspection.

The compressor that furnishes the air is a model 15-B, Type 40, two-stage, air-cooled unit rated at 61 cubic feet at 870 rpm. It is mounted at one end of a material storage rack and is motor-driven through V belts. The machine functions automatically, being controlled by pressure changes. A visual check is kept on the regulating devices by a pressure gauge, which is tapped into and mounted at eye level on a column supporting one corner of the platform on which the unit is set. Under ordinary shop activities it is operated only a short time each day. Because of the large storage capacity of the building framework it is possible to work for several hours without running the compressor, thus permitting the latter, or its driving motor, to be overhauled without the need of operating the shop on short air rations.

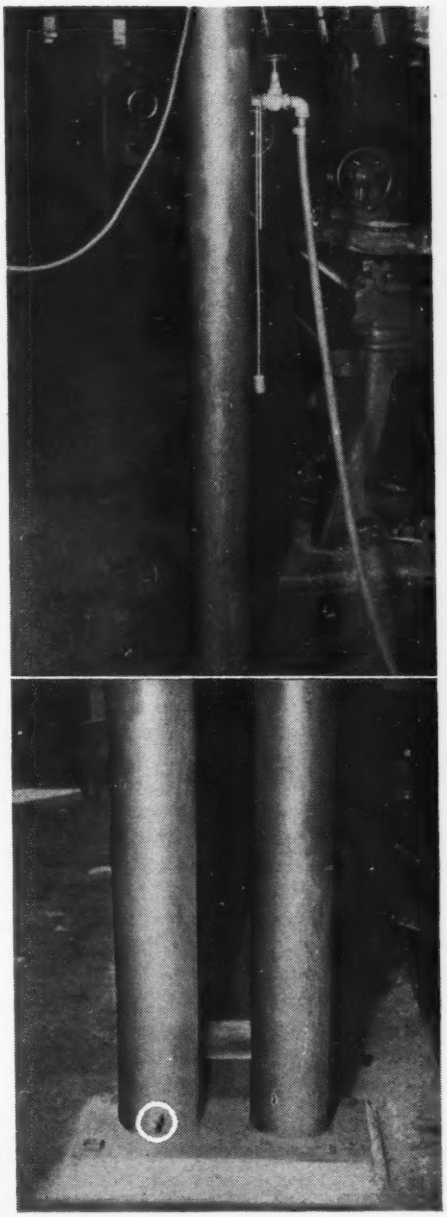
The compressor discharges through a short line into the midsection of a small receiver fashioned from a length of 10-inch pipe. There most of the moisture in the air condenses and falls to the bottom, from which it is discharged to atmosphere by an automatic float-equipped trap. A manually controlled valve, set some 6 inches above the base of the receiver, provides for hand purging in case the trap fails to function properly. At the top of the receiver the air flows through a check valve and the usual main-line stop gate, entering the nearest section of the structural piping system at the level where the center and the side-bay roof-supporting members meet.

The Forsyth shop does general machining jobs for the various industries in and around Houston, specializing somewhat in the making of inventors' working models, special machines, and the like. It is well equipped for reworking the cylinders of high-pressure, high-capacity compressors such as are used in gas-repressuring stations and in trunk gas-transmission systems. The last time the writer visited the shop it was in the thick of trying to bore and ream to plus or minus 0.002 inch a 16-foot metering run of 12-inch extra-heavy pipe.



BUILDING EXTERIOR AND SECTIONAL SKETCH

The drawing shows how the dual-purpose piping supports the multiple quonset-type structure. Flooring is laid on the overhead horizontal piping on each side of the central bay to provide storage areas for materials.



OUTLET AND DRAIN PLUG

One of the numerous air connections, with hose line attached, is shown in the upper view. The outlets are at convenient heights, and those in the rows of double columns bordering the central bay take off from the outer pipes and on the side away from the craneway. Pictured below is the base of a pair of columns with a plug (circled) in one of them for draining off condensed moisture during periodic inspection. Note the crosswise air connection between the risers. On another column, not shown, an air-pressure gauge is mounted at a height where it is readily visible.

Pneumatic Tree Pruning

ADDITIONAL information has come to hand on the rapid rise on the Pacific Coast of pneumatic pruning of fruit trees, which was briefly mentioned in our November, 1948, issue (*Air Power—the New Farm Hand*). Indicative of the economic importance of this development are published estimates by some authorities that the general adoption of power pruning might save California orchardists alone as much as $25,000,000 a year. Articles on the subject have appeared in several trade papers that circulate among fruit growers. Much of the printed material is based on data gathered by the College of Agriculture at Davis, Calif.

It is generally agreed that pneumatic pruning is most effective when done from mobile platforms or towers which enable workmen to reach all parts of the trees with ease. These structures must be built to meet the conditions in the particular groves where they are to be used. They range from slender, high, 1-man towers for trimming tall trees to 2-, 3-, and 4-man assemblies with platforms as large as 10x16 feet for cutting lower ones. Some of the latter type have catwalks with slipboards that can be extended into the trees to permit pruning limbs closer to the trunk.

Most of the platforms are mounted on trucks, small tractors, or trailers. Others are self-propelled and are ordinarily powered by a 3- or 5-hp. gasoline engine that also drives the compressor that furnishes air for operating the pruning shears. Single-platform rigs work well with trees up to 12 or 15 feet in height. For higher ones such as pear trees platforms are often provided at two levels. Units for trimming very tall trees may have a "crow's-nest" at the top.

Some rigs have all controls on the working deck, thus obviating the need of a special driver and making it unnecessary for a member of the pruning crew to climb down to the driver's seat when it is desired to move the outfit. So far there has been little standardization of the carriages or towers, most of those in service having been built by the orchardists themselves, or to order. Latest estimates give the number that were in use in California in the 1947-48 season as between 400 and 500, as compared with from 60 to 80 in the preceding one.

Obstacles to platform trimming are occasionally encountered. They include trees too closely spaced to permit the equipment to pass through, and soils that become so heavy in the rainy season that rigs on ordinary pneumatic-tired wheels bog down. The first difficulty is sometimes solved by cutting the trees back sufficiently to let the carriage through. Future plantings would be spaced wide enough apart in one direction to provide ample clearance. The handicap of muddy soil can be overcome by using either tires of greater width or multiple wheels.

EASING THE JOB

Pneumatic shears and mobile platforms have made tree pruning simpler, safer, and less tiring than the old hand method. An extensible platform enables the workman on the right to reach inside limbs with relatively short, easy-to handle shears.

COMPRESSED AIR & GAS INSTITUTE PHOTO

HORSE-DRAWN OUTFIT

One of the earlier homemade rigs which are being supplanted by power-drawn or self-propelled carriages. The platform puts workmen within reach of the higher limbs. A gasoline engine-driven air compressor is mounted underneath. Using such an outfit, two men with pneumatic shears can trim ten trees an hour, or about an acre a day.

At the start, pneumatic pruning was done from the ground, and shears with very long handles were required to reach high limbs. The results were not wholly satisfactory chiefly because the operators developed sore necks from having to look up well-nigh continually. Also, stubs of previously trimmed branches interfered with cutting limbs at higher levels. Working from ladders was next tried, but that method was unsafe, time-consuming, and so arduous that men would not stay long on the job.

All these problems were solved by the adoption of towers and platforms which put the men close to the work where they can use shorter shears and which elevate them so that any stretching that has to be done is in a horizontal plane and, consequently, not unduly tiring. Some growers still provide their pruners with shears from 5 to 9 feet long to enable them to reach all limbs, but those utilizing platforms with extensible sides find that even inner branches are accessible to 24-inch shears. The latter are easy to handle and control, and operators can make the maximum number of cuts per minute and at the desired angles.

Experience thus far indicates that

pneumatic pruning as compared with the manual method lowers the man-hours of labor by from 20 to 50 percent, the reduction depending upon the kind of tree. The largest savings are effected with trees requiring the most detailed cutting, examples being peach, plum, apricot, and pear. Lesser but worth-while economies are recorded in apple and prune orchards. The least favorable, but still good, results are obtained in the case of fig, almond, and walnut trees, as well as grape vines. So far citrus-fruit growers have applied pneumatic pruning only to lemon trees, with savings comparable to those possible with other fruit trees.

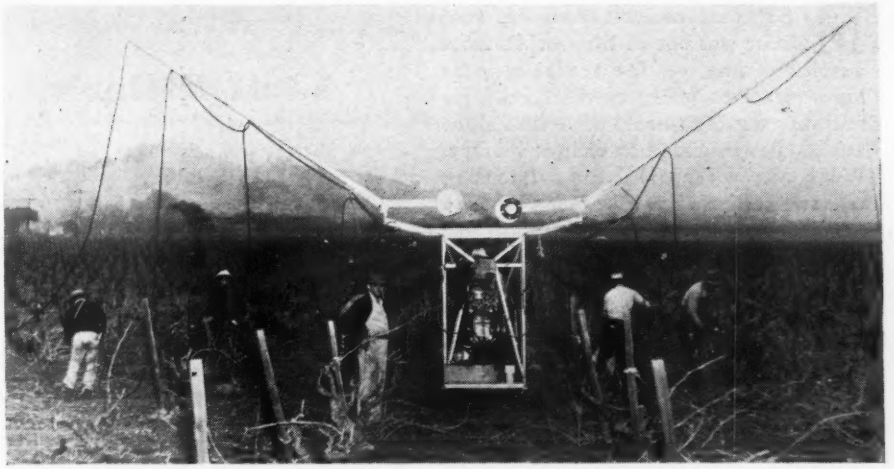
An orchard-pruning outfit, complete with working carriage, air compressor, and shears, now involves an expenditure of from $1000 to $1200. Manual-trimming costs vary with the tree, but run around $45 per acre for Japanese plums and $60 for peaches. On this basis, a grower with 25 acres of peach trees can save money by switching to the mechanical method. For the average "stone-fruit" orchard having trees of several varieties, E. F. Seer, one of the College of Agriculture's pomologists, sets 50 acres as the minimum size that will justify the purchase of pneumatic equipment. The pruning season ordinarily lasts for from 90 to 100 days, and a 2-man rig can, on an average, cover an acre a day.

One noticeable result of pneumatic pruning is that it attracts a more desirable type of worker than does manual trimming. Many of the men are mechanically minded and exhibit an interest in the job that was lacking when they were given the tiresome work of manipulating hand shears from a ladder, which had to be wrestled about from time to time, often in the mud.

Although they have but recently come into the spotlight, pneumatic shears were introduced some ten years ago. They were favorably received, but the wartime shortage of materials and labor interrupted their manufacture and they have been in considerable supply only in the past two or three years. Several Pacific Coast firms are making them, and they are becoming available in the coastal fruit-growing states through dealers. In general, two sizes have been developed: one for cutting limbs up to 1 inch in diameter, and a larger one for branches up to 1⅜ inches thick. The usual working pressures range from 120 to 150 psi. Air consumption is around 4 cfm. for the small tool and about double that for the other.

Individual makes of shears now obtainable differ from one another in some respects, but all have trigger-handle control for the closing operation. In some types closing is effected by pneumatic power and opening by a spring; in others both actions are air-powered. In general, shears designed for trimming small limbs are closed snappily by a small, short-stroke pneumatic-cylinder piston that will make as many as 120 strokes a minute. Bigger units have a slower movement imparted by a longer piston. In either case, fatigue induced by hand pruning is largely eliminated. The power tool also makes cleaner cuts than hand shears, leaving no ragged or split ends that tend to decay.

Carrying the pneumatic-pruning idea a step farther, a Yakima, Wash., firm has devised an air-operated circular saw, about 3 inches in diameter, for branches that are too thick to be readily severed by shears.



COMPRESSED AIR & GAS INSTITUTE PHOTO

PRUNING GRAPEVINES

A tractor-drawn air compressor supplies power for six shear operators, each of whom trims a row of vines. Air lines are carried on counterweighted masts and have a vertical drop for each tool. Since the rate of progress is determined by the pace of the slowest worker, vineyard owners try to put evenly matched men on pruning jobs. Savings of pneumatic pruning over hand methods average around 15 percent and are lower than for tree trimming but still sufficient to promise widespread adoption of power tools.

THE PLATFORM REVOLVES

Using a turret from a war-surplus Grumman "Avenger" plane, Schichtl Bros., Yakima, Wash., machinery firm, builds a pruning rig (right) with a revolving platform. The tractor that draws it also operates an Ingersoll-Rand 5-hp. compressor (above) to supply power for the pruning shears.

Adolf Hitler's Dream of a New Continent

MOST persons will concede that Hitler was one of the world's most ambitious men, yet few realize how far his aspirations really carried him. He not only wanted to rule the entire globe but he also intended to change its face. What was perhaps his most imposing scheme, according to *The South African Mining and Engineering Journal*, was that of damming the Mediterranean Sea to reclaim much of its basin and to irrigate the Sahara Desert. His new "continent" was to be created in the following manner.

That the Nazis gave serious thought to the project is proved by the fact that it was given publicity in four languages under the title of *Lowering the Mediterranean—Irrigating the Sahara*. Copies of the publication, complete with maps, diagrams, and engineering drawings, are in Johannesburg, South Africa, and presumably in London and elsewhere. The plan was drawn up by Herman Soergel, Hitler's "consulting engineer," who combined with it a scheme of flooding the Sahara that was first proposed in the Victorian era.

According to Soergel, some 50,000 years ago (after the Ice Age and the appearance of the Neanderthal man) the Mediterranean Sea was an inland lake, the surface of which was some 3000 feet below the present level. At that time the continents of Europe, Africa, and Asia were not separated by water. The Mediterranean was formed during the last period of the Ice Age when huge masses in the northern Atlantic melted, sending water streaming past Gibraltar into low-lying lakes in the interior.

Soergel believed that the Mediterranean, because of its origin, is in perpetual danger of drying up. Its level, he said, is maintained chiefly by the Atlantic Ocean, the inflow through the Straits of Gibraltar amounting to about 3,100,000 cubic feet a second. By way of the Dardanelles, the Black Sea contributes approximately 170,000 second-feet, while rivers such as the Tiber and Po in Italy, the Rhone in France, the Ebro in Spain, and the Nile in Egypt, add some 2,500,000 second-feet to the flow, making a total of 5,770,000 second-feet. (*Editor's note: The figure stated for the inflow of these rivers seems abnormally high, but is the one given in our source material.*)

Soergel estimated that by the normal process of evaporation throughout the 1,250,000 square miles of surface approximately 5 feet of water is lost annually. This is equivalent to about 5,530,000 second-feet, or nearly as much as the amount entering the Mediterranean. "Therefore," he stated, "if we stop the inflow at Gibraltar and the Dardanelles, closing up the sea with dams, its height will gradually decrease through evaporation of the water."

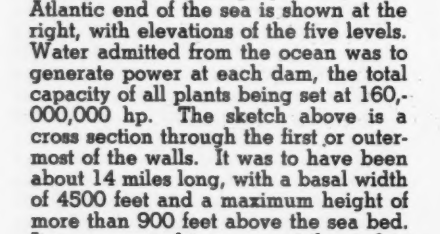
The barrier at the Atlantic end was to be in the form of a series of walls that would lower the level of the Mediterranean by steps. They were to be built by towing pontoons, carrying 10,000 tons of cement each, to the respective sites and sinking them. That the task proposed was one of Herculean proportions is revealed by the cross-section of the wall at Gibraltar which, alone, would have required some 13,000 million cubic yards of material.

With the inflow at Gibraltar and the Dardanelles shut off, Soergel intended to deliver water from the Mediterranean to the Sahara Desert to make it productive. "From the very start, the Mediterranean project must be accompanied by the irrigation of the Sahara .... After closing the main supply it is only by means of artificial water extraction that the natural processes of evaporation and depletion can be accelerated sufficiently to put the project on an economic basis." How the salt was to be removed from the water to render it fit for agricultural purposes was not divulged.

The lower part of the Sahara was to be irrigated by means of a canal extending from Gabes, Tunisia, to a distribution system in the interior, while other sections were to be supplied with water by a pumping station to be constructed at the Siwa Oasis which lies 200 feet below sea level. It was not the purpose of the plan to dry up the Mediterranean; rather, enough water was to be allowed to enter so as to maintain the level at a predetermined point. The incoming water was to help drive giant power plants with an estimated capacity of 160,000,000 hp. at Gibraltar and 7,200,000 hp. at Gallipoli.

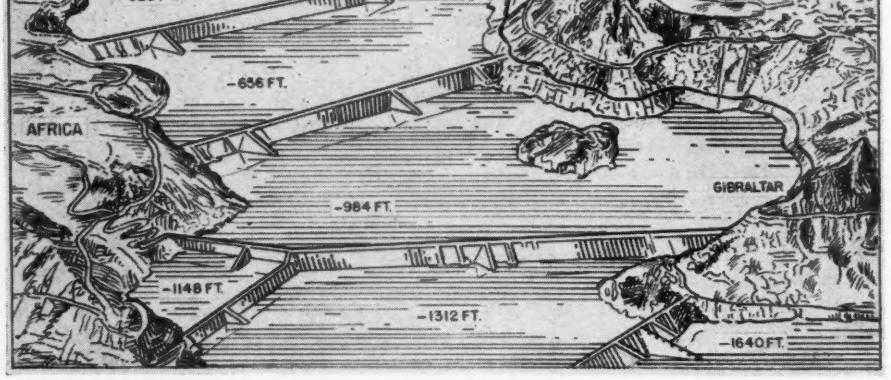
Lowering the Mediterranean to the 656-foot level would uncover some 330,000 square miles of land, which could be greatly increased at any time if more were needed All of it would be arable, the salt being gradually extracted as in the case of the Zuider Zee in Holland. The area in the Sahara desert to be irrigated under Hitler's scheme included sections north of Nigeria, southwest of the Gulf of Tunis, and roughly from Bengasi to the Nile, and was far larger than that which would have been exposed around the Mediterranean.

Final steps in the project involved the building of locks at Port Said, Gallipoli, and Gibraltar to permit navigation; development of the area; and the construction of highways, etc , for the reclaimed land and for the newly cultivated districts of North Africa.



SOERGEL'S SCHEME FOR DEWATERING MEDITERRANEAN

The system of dams projected for the Atlantic end of the sea is shown at the right, with elevations of the five levels. Water admitted from the ocean was to generate power at each dam, the total capacity of all plants being set at 160,000,000 hp. The sketch above is a cross section through the first or outermost of the walls. It was to have been about 14 miles long, with a basal width of 4500 feet and a maximum height of more than 900 feet above the sea bed. It was proposed to carry out the undertaking in stages, thus increasing the area of land as need for it developed. It was computed that the erection of the dams at Gibraltar and the Dardanelles would reclaim 330,000 square miles from the Mediterranean.



This and That

Record Mining Advance

A record for tunneling from a working mine shaft is claimed by Marieville Consolidated Mines, Ltd., one of a group of gold mines in South Africa operated by Union Corporation. In 26 working days a crosscut was driven 1227 feet from the No. 1 Shaft to the Kimberley Reef. This represented an average daily advance of 27.2 feet. The average number of rounds drilled and blasted was 5.7, and the average progress per round was 4.7 feet. The best day's performance accounted for an advance of 34 feet, achieved by completing seven rounds. The size of the heading is not reported. This record was made by the same mining crew that set a previous high mark at Grootvlei Proprietary Mines. A mechanical loader was used in both instances.

★ ★ ★

Air Floats Ship for 7 Years

The 26,600-ton German battle cruiser *Derfflinger*, which was scuttled along with the rest of the Kaiser's war fleet on June 21, 1919, in Scapa Flow off Scotland, has just been broken up for scrap in a British shipyard. Of special interest in connection with the vessel's disposal is the fact that she was kept afloat, bottom-side up, for seven years by continually pumping compressed air into her leaking hull. Actually, the *Derfflinger* was maintained in this condition for three years longer than she served the German navy right-side up. This came about through the intervention of World War II, which broke out shortly before the raised ship was to be towed down the coast of Scotland to a yard well equipped to reduce her to scrap. Rather than permit her to sink once more to the sea bottom from which she had been reclaimed and lose the time and money that had been spent in bringing her to the surface, her salvors preserved her buoyancy throughout the duration of the war.

As recounted in detail in a recent issue of *The Engineer* of London, the capsized *Derfflinger* was refloated in 1939 by Metal Industries, Ltd., in the following manner: Several tubular air locks, long enough to reach above the surface of the water, were attached to the hull. After that, the interior was subdivided into compartments and all hull openings were closed. That done, the vessel was dewatered sufficiently by controlled pumping of compressed air to cause her to rise to the surface, still bottom up. Short air locks were then substituted for the long ones and small structures built on the flat bottom to accommodate workmen and to house compressors, which were operated as required to compensate for escaping air.

Upon the outbreak of hostilities the cruiser was moved to a bay in Scapa Flow and remained there until September, 1946, when she was towed down the coast to the estuary of the Clyde River. Her final resting place was the port of Faslane that had been established during the war in the Gareloch, a sheltered deep-water area, to serve Glasgow in case that city's piers should be put out of commission by enemy action. No graving dock being available, the *Derfflinger* was berthed in a floating dry dock. To facilitate towing and docking, which had originally been scheduled for Forsyth, the funnels, masts, conning towers, and other protruding structures had been partially removed before the ship left Scapa Flow. However, it was necessary to lower these members still further to reduce her draft to well within the 39½-foot maximum water depth of the dry dock. When this had been accomplished by means of explosives placed by divers, the hull of the once proud fighting ship was towed into the dock, which was then raised to permit her dismemberment with acetylene cutting torches.

★ ★ ★

Starter for Jet Planes

The recent development of a pneumatic self-starter for turbojet and turbopropeller aircraft has, the U. S. Navy states, solved one of the major problems in connection with jet-powered flying. As expressed by Rear Admiral Theodore C. Lonnquest, assistant chief of the Navy's Bureau of Aeronautics for Research and Development, the new device meets the need for a starter of sufficient power that is small enough and light enough for use on jet planes. The appliance, which was designed and made by the Air Research Manufacturing Company, Los Angeles, Calif., consists essentially of a small gas turbine-driven, radial-type, air compressor that supplies the necessary power for operating air-motor starters on a plane's main gas-turbine engines. Energy for putting the primary unit in action comes from a ¾-hp. electric motor.

Conventional starting mechanisms have been actuated by electric motors that usually obtain their current from storage batteries. These systems have worked well on ordinary aircraft driven by reciprocating engines that require only from 2 to 4 hp. for starting. However, the newer jet engines need from 10 to 250 hp., and electrical equipment in that range is so heavy as to add undesirable weight to the plane. As a compromise, smaller apparatus has been employed despite the drawback that it is good for only a few starts because of the limitation in size of the storage batteries. Adequate external starting systems have been provided at large plane bases, but there has still remained the problem of insuring positive starting of jet aircraft at out-of-the-way places where full ground crews and equipment are lacking.

The new air-starter apparently eliminates all these difficulties. Complete, the unit weighs only 104 pounds. It can be used repeatedly for an infinite number of starts, and has the added advantage of not being mere dead weight after a plane is in the air. When in flight, the compressor can supply air for cabin pressurizing and air conditioning, or for operating de-icers or other power-consuming devices.

Following a demonstration of the starting mechanism at the Air Matériel Center in Philadelphia, Pa., Navy officers declared that it would greatly increase the effectiveness of jet-powered aircraft in warfare. They added that the Navy alone has spent around $2,000,000 in its search for a starter possessing the qualities of the one that is now available.

★ ★ ★

Stephenson's Opinions on Railroading

A letter written by George Stephenson in 1841 and recently discovered in the archives of the British Ministry of Transport expresses interesting views on transportation in that era as they occurred to the pioneer locomotive designer. Noting the abundance and variety of the notions advanced by young engineers, Stephenson urged that the government step in to "prevent wild and visionary schemes being tried at great danger of injury or loss of life to the public." He was especially apprehensive about brakes, because numerous persons were turning their attention to self-acting ones. He predicted that satisfactory devices would be developed, although 28 years were to elapse before George Westinghouse solved the problem with the aid of compressed air. In the meantime, Stephenson urged that no train should be allowed to travel that did not have two "breaksmen," and he thought four coaches in each train should be provided with "breaks" to allow for contingencies. Other recommendations advocated by him were that the speed of locomotives should be limited to 40 miles an hour on the most favorable lines, "excepting on special occasions," and that speed on curves be diminished according to the radius. He considered 6-wheeled engines safer than 4-wheeled ones, and suggested that the rims of all railway wheels be of the same width. Evidently, the need of standardization was making itself known even then.

The Colorado River Water Question

EDITOR'S NOTE: An editorial, *Precious Water*, in our October issue called attention to the serious need of water in California and mentioned that the state is seeking from the Supreme Court a permanent division of Colorado River water among the three "southern-basin" states—California, Arizona, and Nevada. The following presentation of Arizona's side of the water-allocation controversy was written by the executive secretary of the Central Arizona Project Association.

Howard J. Smith

THE Central Arizona Project, deemed feasible both economically and engineeringly by all concerned Federal executive agencies, would transport to Arizona's vast central agricultural empire part of that state's allotted Colorado River main-stream water supply. It would not take a single drop of California's water. It would not cut off a single faucet or disturb the operation of a single industrial plant in Southern California. It would not, for instance, interfere one iota with the supply of water for the Metropolitan Water District.

Here is the Colorado River water fight in a nutshell:

1. The water in the Lower Basin (substantially California, Arizona, and Nevada) has been divided by "The Law of the River," a series of eight documents or group of documents beginning with the Colorado River Compact and including California's own self-limitation act and the California and Arizona contracts with the Federal Government.

In this division, California has forever limited herself to 4,400,000 acre-feet (an acre-foot is the amount of water needed to cover one acre one foot deep) annually from the main stream of the Colorado River, plus one half of the surplus to be divided in 1963. In the California contracts and the California system of water priorities, this 4,400,000 acre-foot division mark is clearly recognized, and while an additional 962,000 acre-feet is proposed for division, the priorities on all the water above 4,400,000 acre-feet are in a separate and a lower category.

2. Arizona's share of the Colorado River consists of 2,800,000 acre-feet from the main stream, plus the use of the Gila River up to 1,000,000 acre-feet within Arizona's boundaries, plus one half of the surplus to be divided in 1963. This is enough water, by the way, for all present and contemplated Arizona projects, including the 1,200,000 acre-foot Central Arizona Project for supplemental irrigation of 725,000 acres largely lying in Maricopa and Pinal counties.

3. Arizona for a quarter of a century tried to arrive at a firm decision on Lower Basin water. Negotiation was tried and failed. Arizona and California once submitted their case to arbitration, with the governors of the four Upper Basin states as the arbitration board. California has consistently ignored the decision.

As to a Supreme Court decision, Arizona tried twice to carry the matter to the U. S. Supreme Court, and that court said it did not have jurisdiction. Consequently, Congress assumed jurisdiction, and it is now upon the decision of Congress that Arizona waits.

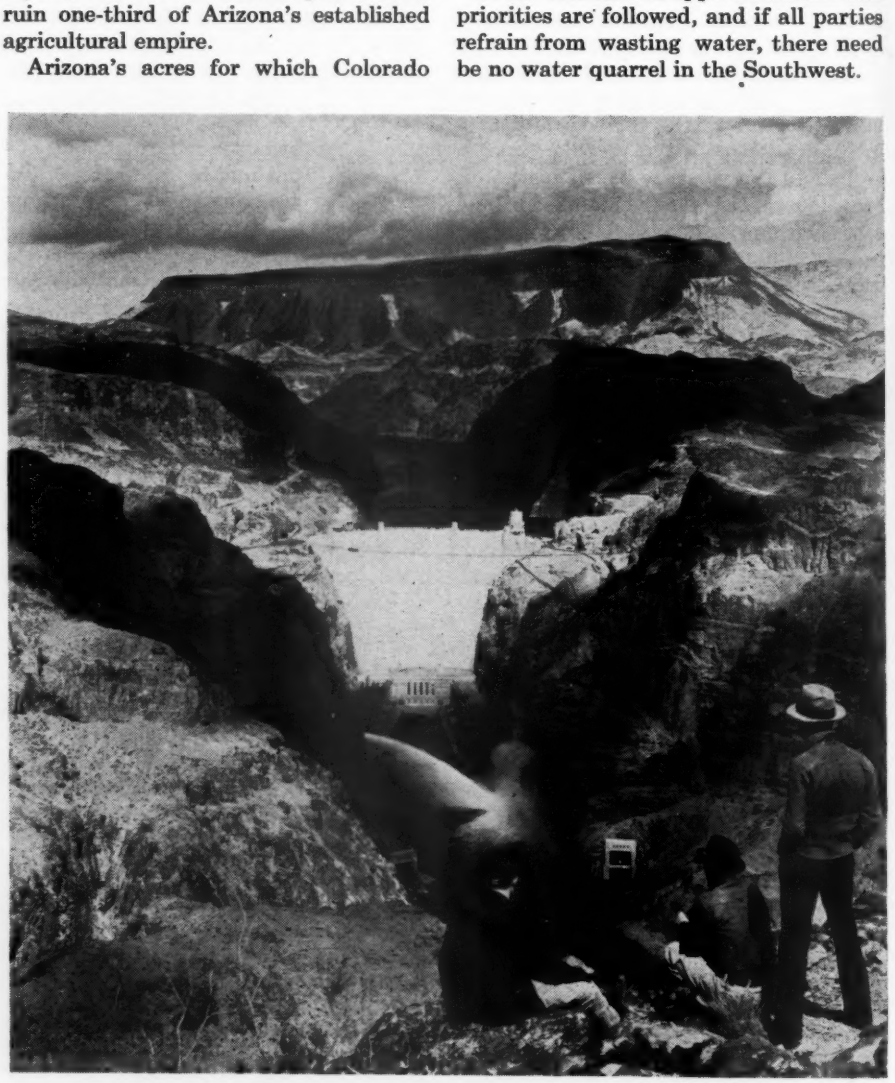
Under Congress' jurisdiction, Arizona was able to obtain her present water allotment, which was less than she historically felt was hers. Nevertheless, she accepted it, signed a contract for that water's delivery (the Arizona contract with the Federal Government signed in 1944), and now awaits delivery.

4. As the instrument for Colorado River water delivery, Arizona has chosen the Central Arizona Project, which, after years of Federal investigation as to soundness and practicality, has received approval of interested Federal departments and agencies. The Central Arizona Project would pay for itself, and more, Secretary of the Interior Julius A. Krug said in his approval of the project report, and it would certainly save from ruin one-third of Arizona's established agricultural empire.

Arizona's acres for which Colorado River water is sought are *presently developed* acres. There is not a single acre of land speculation involved. Arizona, too, has grown in the last few years. The war made heavy demands on Arizona's agriculture and industry. Population increased. Throughout all of this Arizona has made no attempt to take a single drop of water or one iota of any other resource that might belong to any other state.

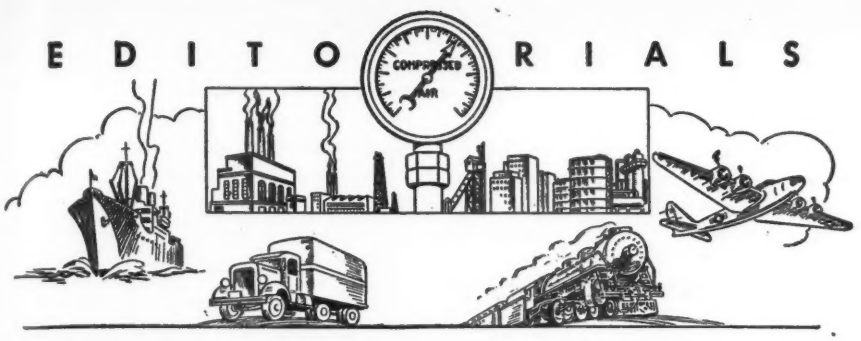
Arizona's relations with the established water districts of California, other than those in the extreme southern part of the state, have been uniformly good. Arizona's friendship with the City and County of San Diego is historic and remains unbroken—Arizona would not deny San Diego a drop of water, and maintains that San Diego is entitled to an ample domestic water supply. In fact, Arizona has no aggressive quarrel with anyone over water. But Arizona cannot stand idly by and see the whole law of the Colorado River swept aside and Arizona's own water misappropriated by others.

If the established apportionments and priorities are followed, and if all parties refrain from wasting water, there need be no water quarrel in the Southwest.



HOOVER DAM WITH FORTIFICATION HILL IN THE BACKGROUND

EDITORIALS



INDISPENSABLE WATER

MANKIND is finding out that water, the earth's most abundant mineral, is also the most valuable one. In many parts of the globe, shortages of this life-sustaining fluid are impeding agricultural and industrial development and giving rise to gigantic alleviating engineering schemes. Actually, the world has enough water for everybody, just as it has enough food, and the problem is one of maldistribution. The tropics and certain other regions are surfeited with rainfall, while other vast areas are parched.

Eastern rivers of the United States carry huge floods to the sea, while great semiarid expanses in the West suffer for want of moisture. Bureau of Reclamation authorities estimate that only about one-seventh of these millions of acres can be brought under cultivation even if the full runoff of the rivers is impounded and distributed.

Southern California has just gone through the two driest years on record, and probably the worst drought since the first Spanish settlers arrived there. Without the Metropolitan Aqueduct, the recent amazing influx of people, that seems to continue unabated, could not have taken place. On the other side of the continent, large cities, notably New York, are reaching farther and farther afield for adequate supplies of water.

Ironically, South Africa, which is generously endowed with precious-mineral wealth, is short of water. This region yields half the world's gold and most of its diamonds but finds its economic expansion temporarily blocked by droughts. There is agitation in the Union of South Africa for a development patterned after the American TVA. Industries and farms, including the largest single citrus-fruit grove in existence, are pinched for water. It is an old problem there, tribal natives having fought for centuries over water holes that mean life to their herds.

In the Orange Free State, bore holes have revealed additional gold-bearing reefs that promise to support a population of 500,000 persons, but mining on any considerable scale must await the importation of water. A pumping plant is being set up under government sponsorship on the Vaal River 45 miles away and will deliver sixteen million gallons daily through a pipe line by 1953. Meanwhile, wells and surface runoff provide meager supplies. New diamond fields in Tanganyika, which may prove to be the richest yet found, cannot be exploited until adequate sources of water are developed. Dr. John Williamson, who came upon the new deposits in 1940, hauled water 7 miles in trucks to carry on initial operations.

In Palestine, pipe lines are being laid to convey water into southerly sections of the Negeb, a Jewish word meaning "The Dry." This desert area of three million acres lying south of Beersheba was once well irrigated, as evidenced by ruins of masonry dams and other works. It is now occupied by Bedouins who roam about with their flocks, sometimes covering great distances to find adequate pasturage. The water will be drawn from bore holes in the northern Negeb and conveyed by pipe manufactured by the British during the war to replace gas and water mains ruptured by the Blitz. Israelites expect this water to support numerous urban settlements, as well as about 1500 farms.

Egypt, too, is feeling the pressure of a water shortage. Construction of the Assuan Dam has been responsible for doubling the population since 1900. If it continues to increase at the present rate it will reach 40 million by the end of the century. Such numbers can be supported only by irrigating desert areas. Egypt has in mind a water-conservation program of unprecedented proportions that is based on investigations by Hamilton M. Wright, an American.

The scheme calls for raising the level of Lake Victoria, which is 3000 miles from the Mediterranean and one of the sources of the Nile River, and also for utilizing nearby lakes Albert, Kwania, and Kioga as storage spaces. Victoria is second in size only to Superior among fresh-water lakes. Development of these facilities would make available 36 times as much water as is now obtained annually through Assuan Dam. Another phase of the project provides for the canalization of stretches of the Nile that now overflow.

Many nations other than those mentioned are seeking supplemental water. Add to these efforts the hydroelectric power developments, extensions of municipal and industrial water-supply systems, storm- and sewage-water disposal networks, and other works that have to do with the harnessing or conveying of water, and it is easy to see that our most common mineral is responsible for a large percentage of the world's engineering planning and construction.

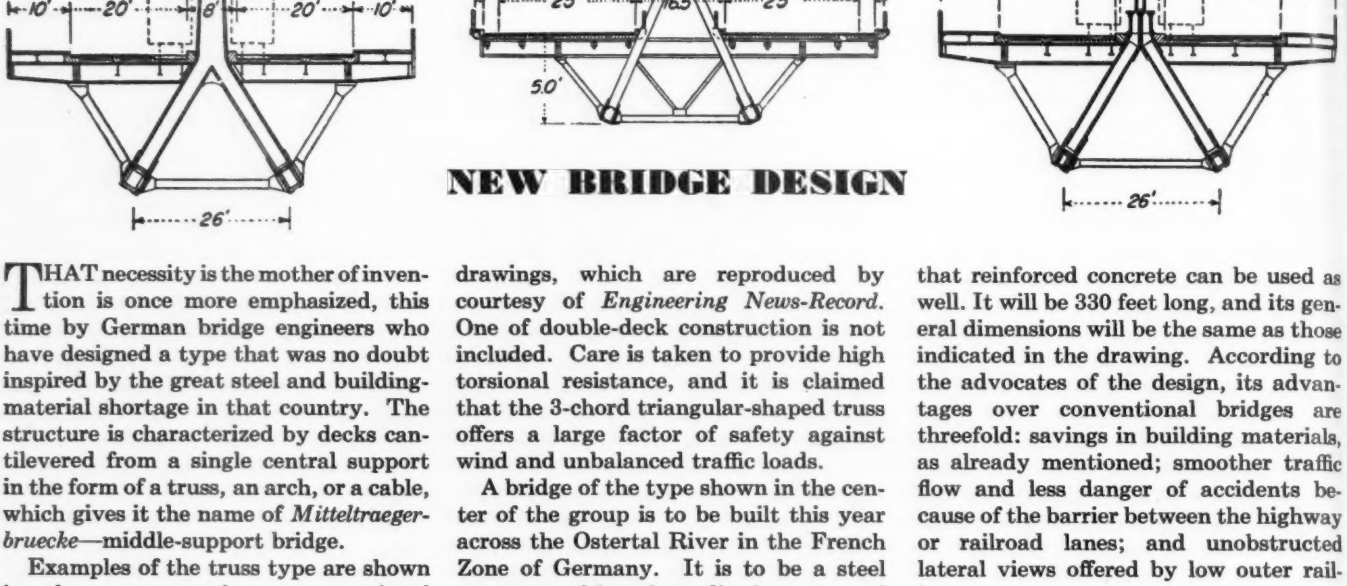
TRENDS IN PROSPECTING

PERUSAL of the article on Labrador iron deposits (Page 32) will give an inkling of how huge a job it is to prove the existence of commercial quantities of ferrous ore in a remote region. Approximately $5,000,000 has already been spent only in exploring the occurrences to the comparatively meager extent of determining that their size and grade justify expenditures for development. That work could obviously have been done only by well-financed companies.

Although this is an unusual example, it serves to remind us that mineral prospecting as a whole has been changed vastly by modern conditions. The storied sourdough, with his burro and sowbelly and beans, is fast passing from the scene. This is not to say that the lone ranger is no longer important. He is, and probably always will be, but now he often travels by air and his traditional pick and pan are sometimes supplemented by geophysical instruments and perhaps a Geiger counter. Searching for metals has ceased to be a shoestring proposition; but hardihood and determination are still essential ingredients of the physical make-up. Along with them must go some financial resources, and a college education doesn't hurt either.

Finding precious metals, especially gold, is ordinarily still within the province of the individual, and today uranium is in that category. Only small veins need to be found and explored in their case, and human muscles will suffice for power. In contrast consider an iron deposit that does not become of value until it has been proved to contain millions of tons. Single ore bodies of Labrador hematite are more than a mile long, several hundred feet wide, and nobody yet knows how deep. Power equipment alone can determine their limits, and then only after years of costly effort.

In view of these circumstances, the Canadian provincial authorities were fully justified in granting prospecting concessions running into thousands of square miles to large and established mining concerns. They have, however, safeguarded the public interest by specifying rental and royalty payments. Nor has the private prospector been overlooked. The agreements provide that the sizes of the concessions shall later be greatly reduced and that the excluded lands shall be thrown open to staking by individuals. Meanwhile, much of this ground will have been probed by the large companies, and their records will benefit those that follow.



NEW BRIDGE DESIGN

THAT necessity is the mother of invention is once more emphasized, this time by German bridge engineers who have designed a type that was no doubt inspired by the great steel and building-material shortage in that country. The structure is characterized by decks cantilevered from a single central support in the form of a truss, an arch, or a cable, which gives it the name of *Mitteltraegerbruecke*—middle-support bridge.

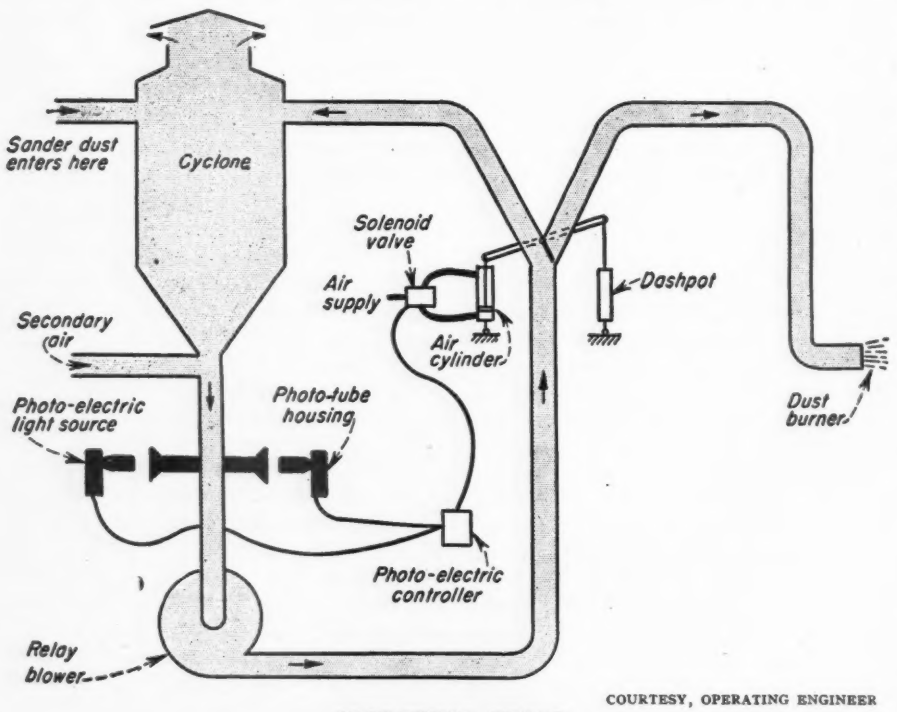
Examples of the truss type are shown in the accompanying cross-sectional drawings, which are reproduced by courtesy of *Engineering News-Record*. One of double-deck construction is not included. Care is taken to provide high torsional resistance, and it is claimed that the 3-chord triangular-shaped truss offers a large factor of safety against wind and unbalanced traffic loads.

A bridge of the type shown in the center of the group is to be built this year across the Ostertal River in the French Zone of Germany. It is to be a steel structure, although studies have proved that reinforced concrete can be used as well. It will be 330 feet long, and its general dimensions will be the same as those indicated in the drawing. According to the advocates of the design, its advantages over conventional bridges are threefold: savings in building materials, as already mentioned; smoother traffic flow and less danger of accidents because of the barrier between the highway or railroad lanes; and unobstructed lateral views offered by low outer railings.

Pneumatic Conveyor Solves Sander-Dust Problem

DUST from sanding operations in woodworking plants is highly explosive when admixed with the proper proportion of air, and it is therefore the practice to collect it as a safety measure. If stored in solid form and burned under boilers to raise steam, as is frequently done in such establishments, it still represents a handling problem. The material has a tendency to bridge over in the bins, and its removal by the use of shakers and special screw-type feeders is not recommended because of the hazard of explosions in the storage spaces.

To minimize the danger, one plant has installed a pneumatic system that conveys the sander dust from the bins to a cyclone where the blower air is separated and exhausted through a top opening while the dust falls into a hopper at the bottom. From there it is withdrawn by a supplemental suction-type blower. If the material that collects in the hopper is of the right density for most efficient combustion, it is delivered to the burner, otherwise it continues to circulate through the cyclone until it reaches that condition.



COURTESY, OPERATING ENGINEER

OPERATING CYCLE

The diagram shows the dust-burning system in the "on" position in which the damper at the intersection of the "Y" is set to recirculate the fuel through the cyclone. When the dust mixture again reaches the proper density for combustion, the beam of light shining on the electric eye is reduced in intensity and causes its relay, through the medium of the solenoid valve and air cylinder, to shift the damper to the normal or "off" position in which the pipe leading to the burner is open. An adjustment on the relay permits changing the density level.

The changeover in the direction of flow is effected automatically by a photoelectric cell that is interposed in the vertical conductor pipe extending from the lower end of the hopper. This device actuates a 3-way solenoid valve which, in turn, admits compressed air to one or the other end of a double-acting pneumatic cylinder in accordance with the density of the feed. The cylinder controls the movement of a damper by which the dust stream is periodically diverted. This is done through the medium of a valve that is connected by one arm to the cylinder piston and by another to a dashpot that serves to cushion the operation.

In case of failure of the power supply or of the photoelectric eye, the system is designed to deliver the fuel to the burner. There are other features such as interval timers which eliminate difficulties that might otherwise be occasioned by concentrations of sander dust at the point of changeover. The burner, itself, directs the flame into the combustion chamber of a furnace and, when suitably provided with Y-valves and blast gates, will serve a battery of furnaces.

AIR-POWERED TUBE CLEANER

ONE of the tasks periodically facing many oil refineries is the removal of spent catalyst from reactor-tower tubes of polymerization units. Depending upon the type of crude oil and operating conditions, the spent catalyst in one and the same reactor tower, or in a group of towers, may vary in character from a hard, consolidated to a gummy mass. When it reaches a condition where reaction ceases, the catalyst has to be replaced with a fresh charge. This creates a maintenance problem, which has been solved, it is claimed, by an air-powered machine introduced by Thomas C. Wilson, Inc., manufacturers of mechanical tube-cleaning equipment. The machine is said to do the work of removal quickly with a minimum of man-power, and thus cuts down production loss by shortening the period towers are "off stream."

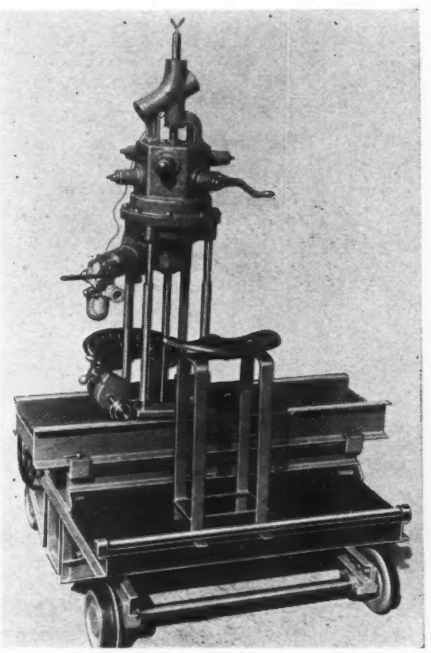
The drill head of the structure is mounted on a carriage which, in turn, rests on transverse rails laid on a movable platform, an arrangement that permits the head to be shifted in any direction. The platform varies in height, according to the distance of the catalyst tubes from the ground, and may be equipped with rail wheels or with rubber-tired casters to run on the ground. In the latter case, screw-type leveling jacks may be provided to make adjustments for inequality in grade, as well as to take the load off the casters when the cleaner is in use.

Powered by a 5-hp. air motor, the drill head is raised and lowered by hand-cranked elevating screws, and a geared hand wheel serves to move the carriage from side to side. The drill rods used are made of steel tubing 1 ⅛ inches in diameter and are rotated by a special chucking device consisting of three grooved drive wheels that grip the rod with a force proportional to the resistance it offers to turning. The wheels are mounted on double-row, radial ball bearings and are free to rotate, thus permitting the drill steel to travel vertically. Up and down feed is effected by the aid of six adjustable friction rolls that are linked together in such a way that all of them can be tilted in the same direction and at the same angle by the movement of a control handle. The latter also makes it possible to vary the rate of feed, depending upon the consistency and hardness of the spent catalyst. Reversal of the lever reverses the movement of the rod without a change in bit rotation or stopping the machine.

The number of drill rods required varies with the type of equipment used and may range from four, each approximately 8 feet long to clean 30-foot tubes 12 feet above grade, to nine 4-feet long for tubes of the same length but 9 feet above the surface of the ground. The first of the series, with the cutter bit attached, is always in the machine to align the latter roughly with a tube. When the unit is spotted and a shroud tube or housing has been put firmly in place, the operator starts drilling by admitting air to the motor and by advancing the feed lever to the up position.

The rod moves upward until its lower end has been drawn past the drive wheels by the friction rolls. Then it stops and at the same time disappears in the housing. This is accompanied by an increase in the pitch sound of the air motor, a combination of conditions that enables the operator to insert the next rod without any appreciable cessation in drilling or shutting down the motor. Rotation continues as soon as he has forced the rod into the feed rolls, and with continued upward pressure it is automatically coupled to the preceding one. Both the bit and rods have joints of the quick-make-and-break type that need no tools for engagement or disengagement.

When the bit has gone the full length of a tube, it is retracted by reversing the feed. As the rod sections pass down through the drill head, they automatically disengage and are removed by hand or, in the case of units mounted on high platforms, are allowed to drop into pipe wells hung beneath the head. Under ideal spent-catalyst conditions, the work of cleaning tube sheets can be done at the rate of 15 feet a minute by two men who have little else to do than handle the drill rods and the controls because the machine itself performs all the other operations.



LOW-PLATFORM TYPE

This unit is designed to remove spent catalyst from tube sheets that are less than 9 feet above ground level and is provided with comfortable seats, one for the man who controls the machine and the other for the man who handles the drill rods. The 5-hp. air motor that rotates the bit and feeds and retracts the steel consumes 150 cfm. at 90 psi. when operating at 2500 rpm. The loosened material drops into the "Y" connection above the drill head and is exhausted by vacuum or other means into a pit or container.

Arena Floor Built to Take Punishment

WHEN hundreds of horses and steers pounded their way over the arena of Madison Square Garden in New York City during a recent rodeo, builders of a floor but newly laid were more interested in its behavior than in watching the great spectacle. In designing it they were faced with varied problems, because the huge structure is the scene not only of Wild West shows and circuses but also of ice hockey and colorful skating revues. About 13 miles of piping had to be embedded in the floor for the refrigerating system, and the 3000-odd joints connecting the sections had to remain tight under the heavy vibrations to which they would be exposed.

Upon the original base, which serves as the foundation for the floor, were placed two layers of waterproofed tar paper topped by zinc sheeting. Next comes the brine-circulating system, which consists of 1¼-inch galvanized, wrought-iron pipe that was supplied by A. M. Byers Company in 20- and 40-foot lengths. These were linked by Flagg-Flow threadless, malleable fittings also 1¼ inches in size to form lines of uniform strength and diameter throughout. The joints were made by brazing with a silver alloy. In and around the pipes, which are attached in groups to headers, was poured a course of concrete, 3½ inches thick, with wire screening embedded in the surface to provide a bond for the ¾-inch terrazzo top coat. The work was completed with the application of a sealing compound.

To insure tightness, tests were conducted at every stage of the job, beginning in the prefabrication shop where the pipe was subjected to both hydrostatic and air pressure at 2500 and 300 psi., respectively. The fittings received what is called a suds test. This involved covering each with soapy water and forcing air at 100 psi. through the pipe. If there were leaks, they were easily detected by the presence of soap bubbles. At the working site, as soon as a header with its series of pipe lines was installed it was filled with water under a pressure of 100 psi., which was far in excess of the average pressure (39 psi.) at which the chromated brine will be circulated through the system.

Industrial Notes

Electrical wire with rubber insulation that is said to improve when soaked in water has been developed by the United States Rubber Company. It is designed for use underground and in wet locations generally.

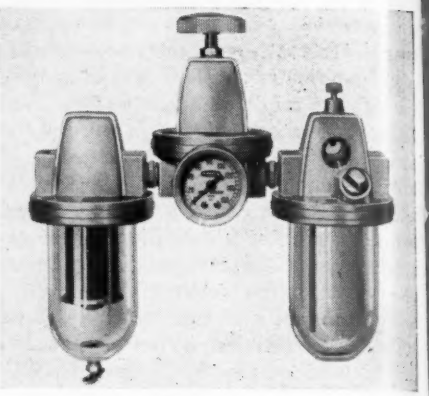
Pipe-fitting covers of Foamglas are being manufactured by Pittsburgh Corning Corporation for use with its Foamglas pipe insulation where exact temperature control is required. They come in all sizes for L's, T's, unions, valves, elbows, and flanges and, being pure glass, do not lose their insulating properties.

Electric Hot Topping is a new metallurgical technique that is said to give a higher than normal yield of sound metal by preventing the formation of cavities in ingots during cooling. The process is patented by M. W. Kellogg Company and is available for use under a license.

It is reported that a specialist in resilient coatings has developed a method of protecting wire rope to increase its service life. By means of the process it is possible to apply neoprene compounds in a smooth, seamless layer that is said to be sufficiently tough and flexible to shield the metal against the harmful effects of acids and alkalies, corrosion, and rough handling.

Liquid Stainless Steel is the name of a new coating made by the Lockrey Company for wood and metal. It is a mixture of microscopic flakes of steel, a liquid plastic, and a solvent, and is applied by brush or air spray. The preservative is said to be resistant to most chemicals and to be fire- and waterproof. Recommended especially for the protection of surfaces exposed to fresh or salt water.

For conditioning compressed air supplied to tools, cylinders, and other pneumatic equipment, Hannifin Corporation has developed a three-in-one unit by combining its new Air Warden filter, pressure regulator, and lubricator. The assembly first cleans the air, next automatically controls the pressure, and then adds atomized oil for the lubrication of moving parts. According to the company, the filter removes impurities as small as 50 microns (0.002-inch), moisture, and emulsified oil. It is provided with a blow-down cock for self-cleaning under line pressure. The regulator is designed to insure protection against accidental pressure build-up and permits reducing pressure without exhausting the control valve. The lubricator is suitable for use with primary air pressures up to 150 psi. Rate of flow is controlled by a needle valve, and supply can be replenished at any time. The unit is offered in standard ¾- and ½-inch sizes. Others are furnished upon request.



COMPRESSED-AIR CONDITIONER

From left to right: filter, pressure regulator, and lubricator of the Air Warden type. The unit weighs approximately 10 pounds and occupies 12 inches of space in the air line.

Here's an item of interest to highway departments now that winter is with us. Pennsylvania Refining Company has announced an improved grade of snowplow wax that can be applied quickly by spray gun. It gives the moldboards and wings a hard, slick surface from which the snow slides easily. One gallon of wax covers an area of approximately 300 square feet.

Tubular telephone poles, light standards, gate and fence posts, etc., of galvanized sheet steel are being made in Australia. They have numerous advantages over the wooden type, namely: reduction in weight, saving in space in transit (tubes can be nested); resistance to rot; and ease of anchoring and climbing, the tall poles being provided with slots.

Trouble experienced in cold weather with frozen ashes because of steam used to operate a cylinder that raises dump grates on boilers has been overcome by a changeover to compressed air of which the plant concerned has an ample supply. It was a simple job that pays dividends. The piping remains as before, but the line that exhausted the steam from the cylinder into the ashpit was removed and a 3-way air valve was in-

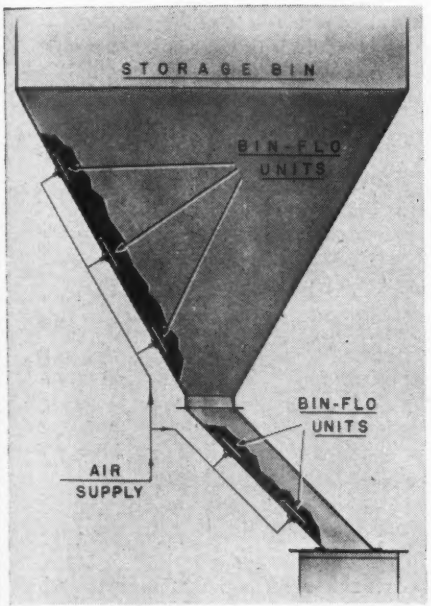
INTERNATIONAL NEWS PHOTOS

TRICKS OF "SILENT" SOUND WAVES

Sound waves of such high frequency that they are inaudible to the human ear can do parlor tricks like those being demonstrated here by R. W. Samsel of the General Electric Company engineering staff in Schenectady, N. Y. At the left, waves from a "whistle" blown by compressed air are being focused by a reflector, much as a concave mirror or a magnifying glass focuses light waves. Their effect is to agitate talcum powder on the table into the rippled pattern shown. At the right, bits of cork are suspended ladder fashion in midair. Waves focused on a point just below the bottom piece of cork rebound and meet others coming down from the reflector. The opposing forces counteract each other and create still areas where the bits of cork remain at rest, apparently in defiance of the law of gravity. These ultrasonic sound waves are being used commercially in several ways, and additional practical applications are imminent. With them, superfine particles of materials in air or in other gases can be agitated and made to collide and combine into agglomerates of a size that can be collected in cyclone separators. Minuscule pieces of carbon black produced by burning natural gas are being recovered in this manner, and the same principle is applicable to the precipitation of various dry or liquid particles that are less than 10-15 microns in diameter. Experiments directed towards the dispersion of fog are also being conducted.

terposed in the pipe leading to the cylinder. Now the latter exhausts to atmosphere and the ashes flow freely also in winter when they used to pile up and, being wet, freeze at an elbow in the vacuum-type conveyor system by which they are exhausted from the pit.

Air instead of vibration is depended upon in a new device designed by The Bin-Dicator Company to keep bulk materials flowing freely from hoppers, chutes, and bins. Bearing the trademark Bin-Flo, the system is suitable for thin- and thick-walled containers of varying construction, including concrete. The accompanying illustration shows a storage hopper of the former type, with five Bin-Flo units located at points along the inner wall where flow might be restricted. Each consists of a ½-inch-



thick plate 3¾ x 7½ inches in size held in place by a locknut and receives air at a pressure of 2 to 5 psi. from a manifold mounted outside, as pictured, or inside where walls are thick. The volume of air introduced is automatically controlled by a fixed orifice in each unit and reaches the bulk material through a special fabric diffuser. The new aerating system is said to be applicable to most dry, finely ground substances.

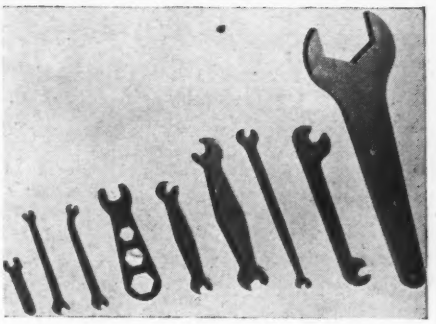
RD-119, a new preparation from the laboratories of the Sinclair Refining Company, is said to impart rust-inhibiting properties to fluid petroleum products. Added to them, the substance is intended to keep fuel and pipe lines, storage tanks, tank cars, tankers, etc., free of rust and scale. The company is making plans to grant others licenses to use the product.

Failure of automobile batteries can be forestalled, it is claimed, by an instrument developed by Socony-Vacuum Oil Company. According to the latter, it is essentially an expanded scale voltmeter that is effective at fluid levels that are too low for the use of the conventional hydrometer. Extensive field tests with the Start-o-Scope, as the device is designated, prove that readings taken every 45 days or less will, in the case of most batteries, accurately predict when failure may be expected.

To keep paint brushes in good condition and ready for use, there is now on the market an airtight aluminum carrier called the Brush Safe. It contains a number of individual compartments with movable clips to suspend brushes of varying sizes at just the right depth in a paint solvent or preserving fluid. There is also a waste tank with an attachment to wring excess liquid from brushes upon removal. All compartments can be lifted out for cleaning. The case is a product of Yenne & North Mfg. Company.

Survey pegs such as are commonly used are apt to be dislocated, even lost, and no one need be told how much grief that may cause. Recent news reports from Sweden announce the introduction there of an improved type that promises to stay put except, perhaps, when disturbed by heavy equipment such as a bulldozer. The peg consists of a special head that is coupled to a piece of standard pipe of any desired length. In the head are three holes through each of which is driven a stiff wire after the stake has been sunk in the ground. The holes are shaped so as to deflect the wires and form a 3-pointed prong. Resistance to movement of this new survey peg varies with the depth to which it is driven and to the length of the wire.

Dayton Rogers Manufacturing Company has announced a service whereby manufacturers may obtain a limited number of custom-made wrenches at a price that is said to be considerably lower than that normally charged for small lots produced by the conventional drop-forge method. According to the company, the wrenches are die cut from such stock as cold-rolled sheet or strip steel,

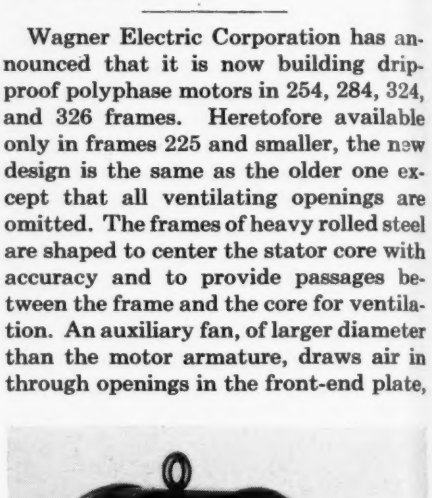


brass, copper, bronze, aluminum, nickel aircraft alloys, and Bakelite and are heat-treated and finished to specifications. Stampings obtainable have a maximum length of 20 inches and a gauge thickness of 1/32 to ¼ inch. By the special process, 100 two-inch-long wrenches of a particular type that would cost $24 when first ordered can be duplicated at $2 for the lot.

Titanium metal, heretofore available only in small research quantities, has advanced beyond the laboratory stage, according to a recent announcement by E. I. du Pont de Nemours. At a pilot plant at Newport, Del., that company is producing the material in sponge form and expects shortly to turn out ingots weighing up to 100 pounds, the daily capacity of the plant. The metal is said to run 99.5 percent and more pure. Im-

pure titanium is brittle; but in its pure form it is ductile and can be readily rolled and drawn. It has a high melting point, is resistant to corrosion, and weighs half as much as steel, properties that qualify it preëminently for reciprocating mechanical parts and for use in jet engines where great heat and pressures are generated. The company will supply small samples of the metal without charge to industrial and university laboratories for testing.

Wagner Electric Corporation has announced that it is now building drip-proof polyphase motors in 254, 284, 324, and 326 frames. Heretofore available only in frames 225 and smaller, the new design is the same as the older one except that all ventilating openings are omitted. The frames of heavy rolled steel are shaped to center the stator core with accuracy and to provide passages between the frame and the core for ventilation. An auxiliary fan, of larger diameter than the motor armature, draws air in through openings in the front-end plate,



forces it through the passages and out by way of the openings in the plate at the drive end. Screens give added protection by preventing rags, paper, etc., from being drawn in and small animals such as rodents from entering. Both sleeve- and ball-bearing motors of the new design are said to be completely dripproof not only when mounted in normal horizontal position but, with the end plates correctly rotated, also in side-wall or ceiling horizontal position. The accompanying illustration shows a 5-hp. ball-bearing motor in the 254 frame.

Another innovation in building materials is a roofing plank, called Durisol, made of steel-reinforced mineralized wood shavings and Portland cement molded under pressure. Top face is surfaced with a ¼-inch layer of cement, and joints are of the tongue-and-groove type. The decking is produced by Durisol, Inc., in thicknesses of 3¼ and 4¼ inches and is said to effect a saving in structural steel of nearly 20 percent. A plank 16 inches wide and 8 feet long supports a load of 40 pounds per square foot and requires no subpurlins.

Industrial Literature

A light-duty soldering tool based on the resistance-heating principle is described in a folder obtainable from Ideal Industries, Inc,. Sycamore, Ill. Termed the Thermo-Grip, it operates on 450 watts and draws current only when a joint is being made. Touching the work with the tool completes the circuit and causes the work to be heated well-nigh instantaneously. The Thermo-Grip is provided with an on-off switch and a pilot light to indicate when the current is on. All leads and attachments are fully insulated.

Raybestos-Manhattan, Inc. will send to anyone interested a copy of Bulletin 6902 describing a guard made by it to protect workmen from exposed trolley wires in underground mines. Of flameproof construction and fully resistant to high voltages, its use has been officially approved by the Departments of Mines of several leading coal-producing states. The bulletin contains installation details and diagrams and can be obtained from the company's Manhattan Rubber Division at Passaic, N. J.

A folder describing a new portable hardness tester for taking Rockwell A, B, and C readings of metal objects can be obtained by writing to the Riehle Testing Machines Division of American Machine & Metals, Inc., East Moline, Ill. According to the manufacturer, the instrument weighs only 3 pounds 6 ounces, yet gives results comparable in accuracy to a bench-type tester. It is suitable for testing pieces ranging in thickness up to 5 inches. The instrument and all accessories are housed in a compact carrying case.

Information on DC 200 silicone fluids is presented in the Dow Corning Silicone Notebook, Fluid Series No. 3, obtainable upon request from Dow Corning Corporation, Midland, Mich. The 32-page publication contains data on the qualities and behavior of these fluids, which are noted for their heat stability, shear resistance, relatively constant viscosity throughout a wide temperature range, high lubricity, water repellency, and good dielectric properties. They are useful as damping and hydraulic media, as liquid dielectrics, as special-purpose lubricants, and as additives, impregnants, and coatings.

Bulletin 7C of the Bryant Heater Company gives data on its industrial gas burners that come as packaged assemblies complete with pressure blowers. Known as Pow-R-Semblies, they are suitable for use with gas-fired boilers, air heaters, driers, ovens, kilns, furnaces, etc., or wherever an open type with controlled flame is needed. Units burn any low-pressure industrial gas and can be operated manually or fitted with semi-automatic or automatic controls. Sizes range in output from 400,000 to 6,600,000 Btu's per hour. Copies of the bulletin may be obtained from the company at 1020 London Road, Cleveland 10, Ohio.

Ingersoll-Rand Company, 11 Broadway, New York 4, N. Y., has issued two new bulletins on centrifugal pumps. Form 7057-A describes its single-stage, general-service pumps with capacities up to 25,000 gpm. against heads as high as 300 feet. They are designed for use wherever large quantities of liquids are to be handled, namely: for circulating cooling water in condensers and in cooling-tower and air-conditioning systems; for transfer service in sugar refineries and chemical plants; as well as for general use in food-packing plants, oil refineries, and manufacturing plants. Form 7148 describes its multistage centrifugal pumps of the

single-suction, opposed-impeller type with horizontally split casings. They are built for pipe-line pumping, boiler-feed service, mine dewatering, and hydraulic purposes generally. Fifteen sizes are available with capacities ranging from 200 to 2600 gpm. and heads up to 3000 feet.

Packing for the Chemical Industry is the title of a booklet recently issued by Crane Packing Company to give as complete a picture as possible of packing requirements and materials for chemical applications. Each style is fully explained and illustrated, and recommendations are made for specific services and temperatures. A section is devoted to Chemlon, a new Crane development. This packing is fully inert in most chemicals, the exception being molten alkali metals. It is available both in braided form and in molded rings, and the uses of each type are given. Copies of the booklet may be obtained from the manufacturer at 1800 Cuyler Avenue, Chicago 13, Ill.

W. C. Dillon & Company, Inc., 5410 West Harrison Street, Chicago 44, Ill., has prepared a bulletin descriptive of an industrial thermometer manufactured by it. The instrument is operated by direct drive from a bimetal coil, is of stainless-steel construction, and has a heat-resistant dial calibrated in either Fahrenheit or Centrigrade. It is designed for use under conditions of vibration, corrosion, or shock; may be placed directly in hot materials with no need for preheating; works equally well with liquids or gases; and can be screwed into tanks, kettles, steam lines, exhaust systems, air ducts, boilers, refrigerators, etc., or affixed to a float for open-tank service. The thermometer is available in dial sizes ranging in diameter from 5 inches to 1 inch and in stem lengths from 4 to 42 inches.

Brown Instrument Company, Philadelphia 44, Pa., has prepared two catalogues to serve as guides in the selection of instruments for controlling industrial processes. No. 7000 describes indicating and recording pressure gauges, recording flow meters, air-operated controllers, nonindicating pressure controllers, indicating pressure controllers for furnaces, precision pressure regulators, etc. No. 15-12 deals with instruments designed for the control of pH and electrical conductivity of liquids and shows their application to different industrial processes. Control of pH in the heavy chemical industry, agricultural chemistry, electroplating, pulp and paper making, industrial research, and in the food and steel industries is explained, as is control of conductivity in water treatment, power plants, and the textile industry.

Hydraulic Institute, 90 West Street, New York 6, N. Y., has compiled data, tables, and charts on the subject of flow of liquids in pipes in *Tentative Standard on Pipe Friction.* The publication is based on the well-known works of Williams and Hazen, but is presented in unique form. Friction losses for water are given in tabular form for pipes made of a variety of materials and ranging in diameter from ⅛ inch to 84 inches. Complete data on friction losses in valves and fittings also is included. There are tables of viscosities and specific gravities covering a wide range of commercial liquids and gases, as well as of dimensions of standard steel, wrought-iron, and cast-iron pipes, permitting rapid and easy computation of friction loss for any liquid or gas in any commercial form of circular pipe. A section describing the use of the tables has several illustrative examples worked out in detail for both simple and complex piping arrangements. Price, $1.50.